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FACULDADE DE CIÊNCIAS ECONÔMICAS
CENTRO DE DESENVOLVIMENTO E PLANEJAMENTO REGIONAL

ALAN MARQUES MIRANDA LEAL

TWO ESSAYS ON THE RELEVANCE OF INTEREST RATES ON CAPITAL FLOWS AND CREDIT

Belo Horizonte
2020

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TWO ESSAYS ON THE RELEVANCE OF INTEREST RATES ON CAPITAL FLOWS AND CREDIT

Dissertação apresentada ao curso de Mestrado em Economia do Centro de Desenvolvimento e Planejamento Regional da Faculdade de Ciências Econômicas da Universidade Federal de Minas Gerais, como requisito parcial à obtenção do Título de Mestre em Economia.

Orientador: Prof. Rafael Saulo Marques Ribeiro

Co-orientador: Prof. Anderson Tadeu Marques Cavalcante

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em universidade pública é uma bandeira a ser defendida, frente aos vários ataques que a universidade pública sofre na configuração política atual. A luta pela educação e pesquisa públicas de qualidade e o acesso aberto e facilitado de populações que tendem a ser excluídas econômica e socialmente foi um fenômeno incrível de vislumbrar, de fazer parte e de continuar lutando pela sua expansão.

RESUMO

O papel de fatores internos como a taxa de juros e PIB em determinar os fluxos de capitais é estudado em longa data. Ao mesmo tempo, muitos estudos postulam como os fatores externos aos países, geralmente taxa de juros e PIB de uma país economicamente avançado, contribuem para determinar majoritariamente o volume e direção desses fluxos de capitais. A primeira pergunta de pesquisa dessa dissertação consiste exatamente em verificar a importância ao longo do tempo dos fatores internos (*pull*) e externos (*push*) que determinam tanto as entradas quanto saídas de capital. Alcança-se este objetivo pelo uso de painéis dinâmicos sobre o banco de dados próprio, construído a partir do Balanço de Pagamentos do Fundo Monetário Internacional (FMI) e outros dados. Os resultados encontrados confirmam a maior importância de fatores internos determinantes de fluxos de capitais no longo prazo quando comparados ao curto prazo, tais como o PIB e a taxa de juros da política monetária. Adições a esses resultados em futuras pesquisas podem ser realizadas ao se considerar fluxos mais desagregados dos dados de fluxos de capitais e que estejam em consonância com a metodologia dos Balanços de Pagamentos do FMI.

Adicionalmente, a dissertação se ocupa a responder outra pergunta de pesquisa, relacionada ao impacto regional da política monetária sobre o crédito. Estudos nessa área consideram majoritariamente métodos de séries temporais (tal como o Vetor Autorregressivo - VAR) e métodos de econometria espacial. Nesse quesito, o presente estudo inova ao construir uma base anual de 2000 a 2016 e ao avaliar o impacto da política monetária e alguns aspectos de políticas macroprudenciais sobre o crédito local fornecido ao nível do município-instituição bancária. Os resultados encontrados direcionam a análise para a existência de impactos importantes dessas variáveis sobre o crédito, ainda com aspectos institucionais e locais impactando essas relações causais. Metodologicamente, os modelos cruzados bayesianos são o principal ferramental de análise, com o uso de painéis espaciais como um teste de robustez aos sinais causais encontrados. Futuras vias de pesquisa podem se enveredar por ampliar o estudo para um maior período e lidar com dados desbalanceados (necessário devido ao painel espacial).

Palavras-chaves: Fluxos de capitais, taxas de juros, crédito, PIB.

Abstract

The role played by internal factors such as interest rates and GDP at determining capital flows is of long-time interest for researchers. At the same time, many studies postulate how foreign variables, in general, interest rates and GDP of an economically advanced country, contribute to determine the volume and direction of the capital flows. The first research question of this dissertation consists of exactly verifying the relevance through time of internal factors (pull) and foreign factors (push), that determine both capital inflows and outflows. We accomplish this task using a dynamic panel on our database, built from the Balance of Payments from the International Monetary Fund (IMF), among other data. The results confirm a larger relevance of internal factors as determinants of capital flows in the long run than in the short run, such as GDP and monetary policy interest rates. Further research might be interested in considering more disaggregated capital flows that are aligned with the methodology of the IMF's Balance of Payments.

Besides, this dissertation attempts to answer another research question, regarding the regional impact of monetary policy on credit. Studies in this area consider largely time series methods (such as Vector Auto-regressive - VAR) and spatial econometrics methods. In this matter, the present study innovates by constructing an annual database spanning 2000 and 2016 and by evaluating the impact of monetary and macroprudential policies on local credit supplied at the municipality-bank level. Results point to the existence of relevant impacts of these variables on credit, with institutional and regional aspects affecting this causal relation. In terms of the methods, Bayesian crossed models are the main toolset used in this research question, with spatial panels used secondarily as a robustness check in the results found. Future venues of research may study these results for a larger period and work with unbalanced data (balancing necessary due to the spatial panel).

Key-words: Capital flows, interest rates, credit, GDP.

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LIST OF INITIALS AND ABBREVIATIONS

ACF Autocorrelation function
AE Advanced Economy
AME Average Mean Group
CPI Consumer Price Index
DD Demand Deposits
DSGE Dynamic Stochastic General Equilibrium
EME Emerging marketing economy
EPFR Emerging portfolio Fund Research
ESTBAN Estatísticas Bancárias
FDI Foreign Direct Investment
FE Fixed-Effects
FED Federal Reserve
FMI Fundo Monetário Internacional
FRED Federal Reserve Economic Data
FX Foreign Exchange
GDP Gross Domestic Product
GFC Global Financial Crisis
GMM Generalized Method of Moments
IMF International Monetary Fund
MCMC Monte Carlo Markov Chain
NTOP5 Non-top 5
OECD Organization for Economic Co-operation and Development
OLS Ordinary least squares
PACF Partial autocorrelation function
PANIC Panel Analysis of Non-Stationarity in Idiosyncratic and Common Components
PIB Produto Interno Bruto
QE Quantitative Easing
RR Reserve Requirements
S&P Standard and Poor's
s.d. standard deviation
SELIC Sistema Especial de Liquidação e de Custódia para títulos federais
SVAR Spatial Vector Autoregression
TD Total Deposits
US United States (of America)
VAR Vetor Auto-regressivo/Vector Autoregression
VIX Chicago Board Options Exchange's CBOE Volatility Index

Summary

Chapter 1 – Introduction

The interest rates play an important role at the economic system. It is one of the main targets the monetary authority uses when implementing a monetary policy. However, its effects on the economy are not limited only to monetary aggregates. The interest rates are also related to the position of a country in the international market, as it is an important variable at determining capital flows to and from a country, also affecting the exchange rates, that is, the interest rates can also be used as an instrument in the exchange rate policies.

In terms of monetary policy, the interest rates changes can affect the monetary and real side of the economy (considering some market imperfections) by different channels, such as the asset prices, credit, speculative, exchange rates, and interest rates. These channels account for the impact of the interest rates increase (or reduction) at prices of assets, with a reduction (increase); at credit, with a reduction (increase); speculative, depending on how the public responds to the monetary authority; at exchange rates, with an appreciation (depreciation); and at interest rates, with a shift of the entire interest rates.

In terms of capital flows, the interest rates usually set the tone for the whole return structure, being an important determinant on whether is worth or not to invest in a foreign country. In that way, a strong relationship between capital flows and interest rates should be empirically reaffirmed.

Given the themes outlined in the previous paragraphs, this work aims at answering two research questions. The first question is: what are the short- and long-run impacts of interest rates on capital flows (both inflows and outflows)? Moreover, are these impacts similar in the short- and the long-run or are they different? By answering this first question, we expect to contribute to the literature by emphasizing the role played by time in conditioning capital flows to interest rates and other variables. We use the GMM-System methodology, as in a dynamic panel, to answer this question in the second chapter.

The second question is related to the impact of monetary policy at the regional level. Here, we aim at answering the following question: what is the role played by changes in the interest rates at determining the level of credit and time deposits in banks at the municipal level? To answer this question, we employ both Bayesian Crossed Models and Spatial Panel Models. Both models can consider the institutional and spatial framework wherein commercial banks operate at the municipal level.

The originality and relevance of answering the first question consists of the perception of the time reality for capital flows. Despite the possibility of using time series methods for capturing the time reality of capital flows, these methods are not suited for working with a large sample of countries, as it is our case (90 countries). The methodology GMM-System allows for estimation of both short-run and long-run coefficients, while also allowing for a comparison between these two coefficients, which we consider a novel approach to the capital flows problem.

In terms of the second question, we aim at capturing the interaction of institutional and municipal reality, that is, we seek to analyze the similarities of the impact of monetary policy between banks located in the same space (municipality) and banks branches belonging to the same institution, countrywide. Furthermore, besides the similarities between space and institution, we seek to analyze the possible differences of the impact of monetary policy between different municipalities and banking institutions. The Bayesian Crossed models allows the estimation of coefficients of impact and the decomposition of the error between different levels of analysis. We are interested particularly at the decomposition of the error term at the municipal and institutional levels and the model can deliver this answer.

Besides this brief Introduction, the remainder of this work consists of Chapter 2, where we tackle the question regarding capital flows, Chapter 3, where we address the question regarding the impact of monetary policy on credit and time deposits at the regional level, and Concluding Remarks, where we gather the main results and suggest some extensions.

Chapter 2 - Heterogeneous effects of push and pull factors on capital flows over time in a dynamical panel data model: the long and the short of it

2.1 - Introduction

Capital flows volume is historically relevant at signaling how developed a country is, with wealthier countries being the target and origin of large capital flows. Additionally, the susceptibility to capital flights and surges of a country is also determined by the volume and volatility of these flows. In that way, advanced economies (AE) tend to be characterized in this subject as having constant and relatively high inflows and outflows of capitals, while emerging market economies (EME) are characterized as having lower flows, either intake or outtake. Besides, EME are more susceptible to financial contagion due to market disturbances which leads to high levels of volatility in the financial account.

There are many works evaluating the determinants of capital inflows and outflows. According to Koepke (2019), these determinants can be classified by pull (internal attraction) and push (foreign attraction) factors. Pull factors are domestic factors that contribute to the attraction of capital or even the availability of capital for foreign investment. In that way, national output, national interest rates, risk in national investments can be considered as good domestic predictors (in general denominated pull) to the trajectory of capital flows in the home country. On the other hand, the foreign income, foreign interest rates, implied risk in foreign investments, and institutional framework of foreign economies can be considered as good external determinants (in general denominated push) of the dynamics of capital flows of the home country.

The pull and push factors theoretical framework advances the portfolio allocation theory set forth by Markowitz (1952) and Grubel (1968). While Markowitz (1952) set forth the notion of the positive relationship between risk and expected return, Grubel (1968) applies the reasoning of this relationship to capital flows between countries. Thus, investors are interested in maximizing their returns even assuming some risk in investing in foreign countries, given that on average this investment is more profitable than those investments in their homeland. Therefore, the interaction of push and pull factors proves to be crucial for investors deciding whether the investment in a foreign country is profitable. This is of course the view of the country that originates the flows.

In terms of the recipient side of the capital flows, these flows can be used in private investments and also hold by governments and central banks as foreign exchange reserves. Naturally, the excess of those flows can also create non-optimal situations, with an expressive reliance of a country on foreign resources and an artificially appreciated exchange rate. The problems created by sudden reversals of movements of both capital inflows and outflows are studied at large in the literature, with a notable work being Ahmed and Zlate (2014).

One key aspect that has been largely neglected by the previous works is the time dimension in which push and pull factors affect capital flows. According to Koepke (2019), studies usually find that in the short-run push factors tend to be more more important in determining capital flows than pull factors, while in the long-run the opposite occurs, that is, domestic determinants outweigh external causes. Nevertheless, to the best of our knowledge, no work has yet empirically tested this hypothesis. Thus, this paper seeks to address this issue by estimating the short- and long-run coefficients of push and pull factors using a dynamical panel data model for a sample of 90 countries over the 1990-2016 period. This methodology allows us to test whether the response of capital flows to changes in the push and pull factors is statistically different between the short- and the long-run. We use the Generalized Method of Moments (GMM) technique by Arellano and Bond (1991) and Arellano and Bover (1995) since this estimator is robust to reverse causality. Our results suggest that pull factors indeed affect capital flows (inflows and outflows) more in the long-run than in the short-run. For instance, GDP per capita and interest rates (monetary policy) impact more capital inflows in the long-run than in the short-run. Analogously, GDP per capita impact more capital outflows in the long-run than in the short-run.

The remainder of this chapter consists of four additional sections, which are Literature Review, Methodology, Results, and Final Remarks.

2.2 - Literature Review

We start this section with a brief review of the theoretical contributions to the analysis of the dynamics of capital flows. The seminal work by Markowitz (1952) applies the concept of portfolio allocation in the analysis of capital flows. This framework is based on the idea that agents search only for earnings differentials while ranking potential investments in the decision-making process. Besides, Markowitz (1952) remarks that investors are also concerned with the risk associated with an investment, i.e., the price volatility of investments. This is the widely known return-risk paradigm of investment formalized by Markowitz (1952). Grubel (1968) expands Markowitz's model to capital flows at the country level, trying to quantify the welfare gains of these flows. One interesting conclusion of this paper is that even if the interest rates differential between two or more countries is equal to zero, there might be a positive flow in absolute terms between them because of investors' desire for portfolio diversification in finance and investment planning. In that way, advanced economies (AE) have more capital available to make investments abroad, even if the interest rates differential is negligible. Lucas (1990) analyzes why capital does not flow from AE to emerging market economies (EME). According to him, this can be explained by factors such as differences in the human capital stock, spillovers related to human capital, and imperfection in the capital market.

There are many theoretical approaches for studying capital flows, both as an investment decision made minimally by the sum of investors of a country or a concerted effort of AE of yielding more earnings from riskier investments. In that way, there is an effort at sometimes microfundamentation of the flows at the level of the country (such as OBSTFELD, 1992), whereas in other situations they are considered purely on an aggregated fashion, either gross or net.

In terms of the empirical literature, there are two main strands of methods used for capital flows causal analysis, which is time-series methods and panel methods. We display some examples of both strands of this empirical literature, while also presenting some works that relied on other methods for their analysis.

In the time series methods strand, De Vita and Kyaw (2008) studied the determinants of capital flows in a set of developing countries (Brazil, Korea, Mexico, Philippines, and South Africa), using disaggregated foreign direct investment and portfolio flows for the period 1976-2001. They find, through a Structural Vector Auto-Regressive (SVAR) model, that a positive shock in the output growth of a mature economy (in this case, the USA) reduces capital flows to the countries of the sample. Additionally, a positive shock in the US interest rate (treasury bonds) seems to increase capital flows towards those countries. Finally, a positive productivity shock in the recipient country increases foreign direct investment (FDI). Next, Dahlhaus and Vasishtha (2014) analyze the impact of FED's interest rate normalization on portfolio flows to 23 countries from January 2004 to January 2014 in a VAR model. The authors use the Emerging Portfolio Fund Research (EPFR) database to verify the size of the impact of the flattening of the US yield curve following the quantitative easing (QE) measures conducted by the FED as a response to the Global Financial Crisis (GFC). They find that the main effect is a reduction of inflows at no more than 5% of GDP to some countries in the sample studied.

In the panel methods, Forbes and Warnock (2012) work with quarterly data of gross capital inflows and outflows on 58 countries from 1980 through 2009, using a binary response model, called complementary logarithmic (or clog log). They define four gross capital flows movements, surges, and stops, when foreign investors decide to increase or decrease, respectively, flows to a nation; and flights and retrenchments, when national investors increase or decrease, respectively, flows to another nation. The authors use a limit of 2 standard deviations (s.d.) to characterize those four episodes, with 2 s.d. upwards for surges and retrenchments, and 2 s.d. downwards for stops and flights, all those deviations regarding the average of the whole period. The authors' results show that the main determinant of these four types of capital flows movements was the global risk. There is also evidence, according to Forbes and Warnock (2012), that countries that grow at higher rates are less likely to experience capital flows retrenchment; that countries with capital controls and small debt are more likely to experience capital flights; and finally, that countries with complex financial systems are more likely to experience capital flows stops. Cerutti, Claessens, and Rose (2019), in turn, partialled out the effect of global financial cycles to assess the determinants of capital flows. They employed fixed-effects panel regressions to a sample of 85 countries from the first quarter of 1990 through the fourth quarter of 2015 and found that global financial cycles are responsible, in average, for only a quarter of the variation of capital flows. Continuing with the panel methods, but also using the push-pull framework, Byrne and Fiess (2011) employ a Panel Analysis of Non-Stationarity in Idiosyncratic and Common Components (PANIC) method for quarterly capital inflows data, from 1993Q1 to 2009Q1, for 78 emerging and developing countries and conclude that the American long-run interest rates (treasury bonds) are an important determinant of capital inflows, of aggregated flows, and disaggregated flows of banks and equity to other countries. However, American short-run interest rates (also treasury bonds) are not as relevant in determining capital inflows. Besides, looking at countries individually, human capital is more relevant in determining capital flows than the degree of financial openness and the institutional framework of a country. Hence, countries with a higher share of skilled workers in the total labor force are more likely to benefit from the financial globalization process. Hernández (2015), in turn, analyzes capital inflows (direct inflows, portfolio inflows, and other inflows) in 18 EME, using an Augmented Mean Group (AMG) model, which allows for a difference in slopes and cross-dependence in a panel modeling. He finds the expected signs for the pull factors, such as country risk, and push factors, such as FED QE and American real GDP growth rate, with the latter outweighing the former as the main contributing factor to the attraction of capital inflows for EME. In a GMM-System panel model for 42 countries from

1990 to 2008, Weiss and Prates (2017) investigate the responsiveness of capital flows to pull factors, such as GDP growth, interest rates, and currency exchange rate, as well as push factors, such as the VIX, US GDP growth, and the Dow Jones Index growth overtime. Their results show that push factors are the main determinants of the size of flows towards countries in the sample analyzed. Next, Clark *et al.* (2020) evaluate the effect of an expansionary monetary policy in the US on the net private capital flows to EME. They criticize the common narrative that lower American interest rates (treasury bonds) and the quantitative easing policy contributed to the surge in capital inflows to EME. By using dynamic panel methodology for quarterly data from EME, they find that the effect of quantitative easing in the US on the dynamics of capital flows towards these countries is overstated. The authors suggest that commodity prices are more important in determining EME's capital inflows, as EME tend to rely heavily on their export earnings from primary commodities.

Employing other methods, Sula (2010) analyses variables that are relevant at explaining sudden stops directed to EME. By constructing a variable that captures surges, the author postulates that if a country is experiencing a surge in capital flows (in his case all capital flows, excluding foreign direct investment), which are not justified by good fundamentals, a sudden stop becomes more likely to happen in near future. Using a PROBIT model for 38 EME, the author concludes that surges do make countries more susceptible to sudden stops, also corroborating the literature idea that bad fundamentals, such as overvalued currency and current account deficits, also contribute to a reduction in capital inflows. Fratzscher (2012), in turn, studies the determinants of capital flows using weekly data from hedge funds for 50 countries from 2005 to 2010 in a step-wise factor model. The author finds that global shocks, such as US economy output shock, affect the capital flows to countries in the sample for all time analyzed. After the 2008 crisis, pull factors, such as the quality of institutions and macroeconomic fundamentals became important in establishing which countries attract more resources from the global market and bonds. Next, Korinek (2018) evaluates the externalities of different types of capital inflows and outflows to EME in both a sufficient statistics framework and a Dynamic Stochastic General Equilibrium (DSGE) model. He concludes that there is a difference between illiquid investments, such as foreign direct investment, and most liquid investment, such as portfolio equity, CPI-index investments, among others. Moreover, foreign liquid investment flows in EME are more prone to reversals or stops, and externalities associated with such movements involve real rate exchange depreciation, inflation, and an increase in current account deficits, which causes through a vicious circle further capital outflows and real rate exchange depreciation. A possible way to address these problems, as the author suggests, is through taxes that aim of reducing the exposition of domestic agents to foreign debts. In terms of capital flows and capital controls, Munhoz (2013) analyzes the controls imposed by Brazilian government on capital inflows and outflows using a VAR model, from January 1995 to December 2011. The study suggests that the impact of the implementation of more strict capital controls (measured as an increase in the tax rate on financial operations) on capital flows and exchange rate are negligible. The author then suggests the adoption of alternative measures of capital controls, such as looking and defining limits at specific accounts of capital flows (those more related to capital inflows/outflows). Following, Li and Rajan (2015) analyze the impact of capital controls on the volatility of capital outflows and inflows, by deploying a panel analysis. To accomplish such a task, they split capital inflows into foreign portfolio investment and foreign direct investment. Through different model specifications, they find that controls on FDI outflows tend to lower the volatility of FDI inflows in a sample of 37 EME over the period 1995-2011. In terms of economic policy, this result suggests that the importance of capital flows controls cannot be overstated. Finally, Ahmed and Zlate (2014) study bank and portfolio flows to 12 emerging economies from Latin America and Asia, from the first quarter of 2002 to the second quarter of 2013, using fixed-effects panel regressions as the main methodology. Their results show that economic growth, interest rates differential between AE and EME, and the aversion to risk are the key factors in determining private net capital inflows to emerging countries.

We innovate in terms of the literature by using dynamic panel methods to calculate long-run and short-run coefficients. By testing whether they are statically identical or not, we provide evidence of different dynamics existing in the relationship between pull and push factors and the capital flows.

2.3 – Methodology

2.3.1 - Data Sources and Variables

We estimate our models for two different dependent variables, obtained from the Balance of Payments data, as provided by the International Monetary Fund (IMF). First, capital inflows are proxied by the Portfolio Liability Debt account, while capital outflows are proxied by the Portfolio Asset Debt. The former account is related to the national debt (of any kind) held by foreign actors. Similarly, the latter account is related to foreign debt held by national actors. Those two accounts include, but are not limited, to government and corporation debts.

The push variables are three: US GDP per capita, US interest rates (FED funds rate), and VIX. The first variable accounts for the economic power of a major economic force. The second variable is the baseline expected return to any safe investment, that is, riskier investments by construction demand a higher return than that provided by US federal government bonds. Finally, VIX is the implied volatility index of the S&P top 500 companies and proxies for the minimum risk appetite of investors of the American market (again a baseline market).

The pull variables, in turn, consist of national GDP per capita, monetary policy baseline interest rates, and FX-implied volatility. Again, the national GDP per capita of country proxies for its ability to sustain a big consumer market and production, that is, it is related to its economic ability in general. Monetary policy baseline interest rate is a proxy for the minimum expected return to the safest bonds of a country (usually federal government-issued bonds). Finally, FX-implied volatility[1] proxies for a country risk appetite, which is used to its generality for the countries in the sample and interpretability.

The following **Table 1** synthesizes the information of previous paragraphs, while also exhibiting the expected signs for each variable and their sources.

Table 1 - Variables of Capital Flows and their sources

Variables	Description	Classification	Source
$Flows_{i,t}$	Flows in debt from and to a country.	Explanatory Variable	IMF's Balance of Payments
$GDP_{i,t}$	GDP per capita in the prices of 2010. We expect this variable to affect positively the flows from and to a country.	Pull	World Bank Development Indicators
$USGDP_{i,t}$	US GDP per capita in the prices of 2010. We expect this variable to affect positively the flows to a country.	Push	World Bank Development Indicators
$InterestRates_{i,t}$	Interest rates. We expect it to yield a positive effect on inflows.	Pull	IMF and OECD

[1] FX is the exchange rate of national currency in terms of the American dollar.

$USInterestRates_{i,t}$	US Interest Rates. We expect the effect to be negative on inflows and positive on outflows.	Push	FRED ST. LOUIS
$VIX_{,t}$	The volatility of the S&P 500, as measured by the implied variance of the 500 companies. We expect the effect to be negative.	Push	FRED ST. LOUIS
$VolatilityFX_{i,t}$	The variance of the FX regarding the exchange of the national currency concerning the US dollar. This variable accounts for the country risk and is expected to be inversely related to capital inflows.	Pull	Author's elaboration

Note: Author's elaboration.

2.3.2 - Dynamic Panel Methodology

The main methodology in this study consists of a dynamic panel, as developed by Arellano and Bover (1995). According to Roodman (2009), dynamic panel estimation is useful when we are dealing with a panel with "small T, large N" and when our dependent variable is a function of its lagged values. In that way, there is a problem of endogeneity[2] in the model because the errors of the model are correlated with the lagged variable. Therefore, it is important to employ some correction in the estimation.

Regarding how pull and push factors affect capital flows across different time frames, we use a dynamic panel as also a tool to measure the short-run and long-run coefficients of those factors upon the flows. Our main specification is the following **Equation (1):**

$$\begin{aligned} Flow_{i,t} = \alpha_i + \beta_0 + \beta_1 * Flow_{i,t-1} + \beta_2 * GDP_{i,t} + \beta_3 * Interest\ Rates_{i,t} + \beta_4 \\ * VolatilityFX_{i,t} + \beta_5 * USGDP_{i,t} + \beta_6 * US\ Interest\ Rates_{i,t} \\ + \beta_7 * VIX_{i,t} + \epsilon_{i,t} \end{aligned} \quad (1)$$

where $Flow_{i,t}$ and $Flow_{i,t-1}$ are respectively the flow to (or from in the case of outflows) country i in the period t and t−1. $GDP_{i,t}$ is the GDP per capita of country i in the period t. $USGDP_{i,t}$ is the American GDP per capita in the period t. $Interest\ Rates_{i,t}$ is the interest rates of country i in the period t. $US\ Interest\ Rates_{i,t}$ is the American interest rates in the period t. $VIX_{i,t}$ is the volatility of Standard & Poor's 500 (S&P 500) options prices.

[2] For an easy proof, check Pesaran (2015).

$VolatilityFX_{i,t}$ is the standard deviation of currency exchange of a country i in the period t, concerning the American dollar. α_i is the fixed effect by country, while $\epsilon_{i,t}$ is the idiosyncratic error in our model.

We use as aforementioned the lagged dependent variable as an important determinant of its current realization. This is theoretically explained by the persistence of the behavior of the dependent variable. Empirically, GMM-System also allows us to answer our question of research in the following manner. In the long term, we consider any realization of capital flows to be equal to its predecessor, hence $Flow_{i,t} = Flow_{i,t-1}$, which simplifies our equation in a way that each coefficient is divided by $1 - \beta_1$. This long-run equation is exhibited in the following **Equation (2)**.

$$\begin{aligned} Flow_{(i,t)} = & \frac{\alpha_i}{1-\beta_1} + \frac{\beta_0}{1-\beta_1} + \frac{\beta_2}{1-\beta_1} * GDP_{i,t} + \frac{\beta_3}{1-\beta_1} * InterestRates_{(i,t)} \\ & + \frac{\beta_4}{1-\beta_1} * VolatilityFX_{(i,t)} + \frac{\beta_5}{1-\beta_1} * USGDP_{(i,t)} + \frac{\beta_6}{1-\beta_1} \\ & * USInterestRates_{(i,t)} + \frac{\beta_7}{1-\beta_1} * VIX_{(i,t)} + \epsilon_{(i,t)} \end{aligned} \tag{2}$$

The coefficients of **Equation (2)** are the long-run effects of the independent variables on our dependent variable. Analyzing the difference between the short-run and long-run coefficients through GMM-System is our main question in this work. We then use the Wald test of equality to verify whether the short-run and long-run coefficients are statistically similar or not. This test follows a chi-square distribution, under the degrees of freedom of the restriction, in this case just one restriction.

As we have a lagged dependent variable causing the current realization of the dependent variable itself, our model is naturally endogenous. To overcome this difficulty, we need to apply an estimation method that addresses this endogeneity as much as the one caused by other problems such as the omission of variables, simultaneity, and error of measure. Generalized Method of Moments (GMM), as in Arellano and Bover (1995), provides a feasible way to address these issues with endogeneity.

There are two ways GMM estimation is implemented in a dynamic panel context: difference, as in Arellano and Bond (1991) and system, as in Arellano and Bover (1995). GMM Difference purges the models of its fixed effects by first differentiating and then it uses the lagged levels of the variables as instruments for their current differences. This device allows consistent estimation of coefficients. There is a caveat, though, which is that GMM Difference's efficacy is diminished by a temporal persistence of the endogenous variable, that is, the current realization of the endogenous variables is highly correlated with its past realizations. GMM-System changes the instrument matrix in a way that accounts for this possibility.

GMM System uses exactly all information available, within the dataset to build its instruments matrix. Alongside the GMM Difference way of using lagged levels as instruments for current differences, it also uses lagged differences as instruments for current levels. This estimator is also consistent and more efficient than GMM Difference.

Given the consistency and efficiency of the GMM-System, there are two additional tests we have to guarantee its non-rejection of the null hypothesis: Hansen over-identified instruments and Arellano-Bond AR(2) tests. Hansen test has a null hypothesis that a set of instruments is exogenous. The Arellano-Bond AR(2) test has a null hypothesis that the idiosyncratic residuals are not serially correlated in the second order.

Besides the GMM-System, which is our main model, capable of correcting the problems in our data, we also display the results of the Ordinary Least Squares (OLS), Fixed-effects (FE), and GMM-Difference estimation to analyze the stability of our coefficients (in the Appendix A.2 e A.3).

Another relevant aspect of the GMM-System consists of the choice of endogenous and exogenous covariates in the model. The choice of the endogeneity or lack thereof in the model directly affects the instrument matrix, as exogenous variables can be used as instruments instrument matrix, making unnecessary the construction of instruments for themselves (which is the case for the endogenous covariates). In that way, we follow a simple rule by choosing the endogenous and exogenous variables. The push factors, which relate to the American economy, can be considered all exogenous, given that the chance of a small country's capital inflows and outflows to affect American variables is reduced for a large part of our sample. The pull factors, in turn, should all be considered endogenous, given that we expect them to not only affect capital flows, but also be affected by capital flows.

2.4 - Results

2.4.1 - Descriptive Statistics

Now, we summarize our data by three devices: first, **Table 2**, which describes the mean and standard deviations of the two dependent variables (capital inflows and outflows) and pull factors in the models of this chapter by whether or not a country is an AE; **Table 3**, in turn, displays the descriptive statistics of push factors; next, we display a pair plot in **Figure 1** of each of the two dependent variables and the pull factors (which differ from the push factors are variant among the countries).

Table 2 - Capital inflows/outflows and pull factors for AE and EME countries

Variable	AE	EME
Capital outflows (in million US$)	17356.11	546.83
	(33834.88)	(2389.09)
Capital inflows (in million US$)	19909.98	1014.70
	(42015.98)	(3786.01)
GDP per capita (in US$)	36271.90	5524.19
	(19509.91)	(8555.13)
Monetary policy interest rates	17.08	87.08
	(790.82)	(124.43)
FX-implied volatility	14.13	78.78
	(82.55)	(394.35)

Note: Standard deviations are reported inside parentheses.

Analyzing **Table 2**, the mean and standard deviation of dependent variables and pull factors display the expected difference between AE and EME economies, with the former exhibiting higher values for capital inflows, outflows, and GDP per capita and lower values for monetary policy interest rates and FX-implied volatility. Next, **Table 3** also displays the same statistics (mean and standard deviation) for the push factors, which are identical between AE and EME.

Table 3 - Push factors

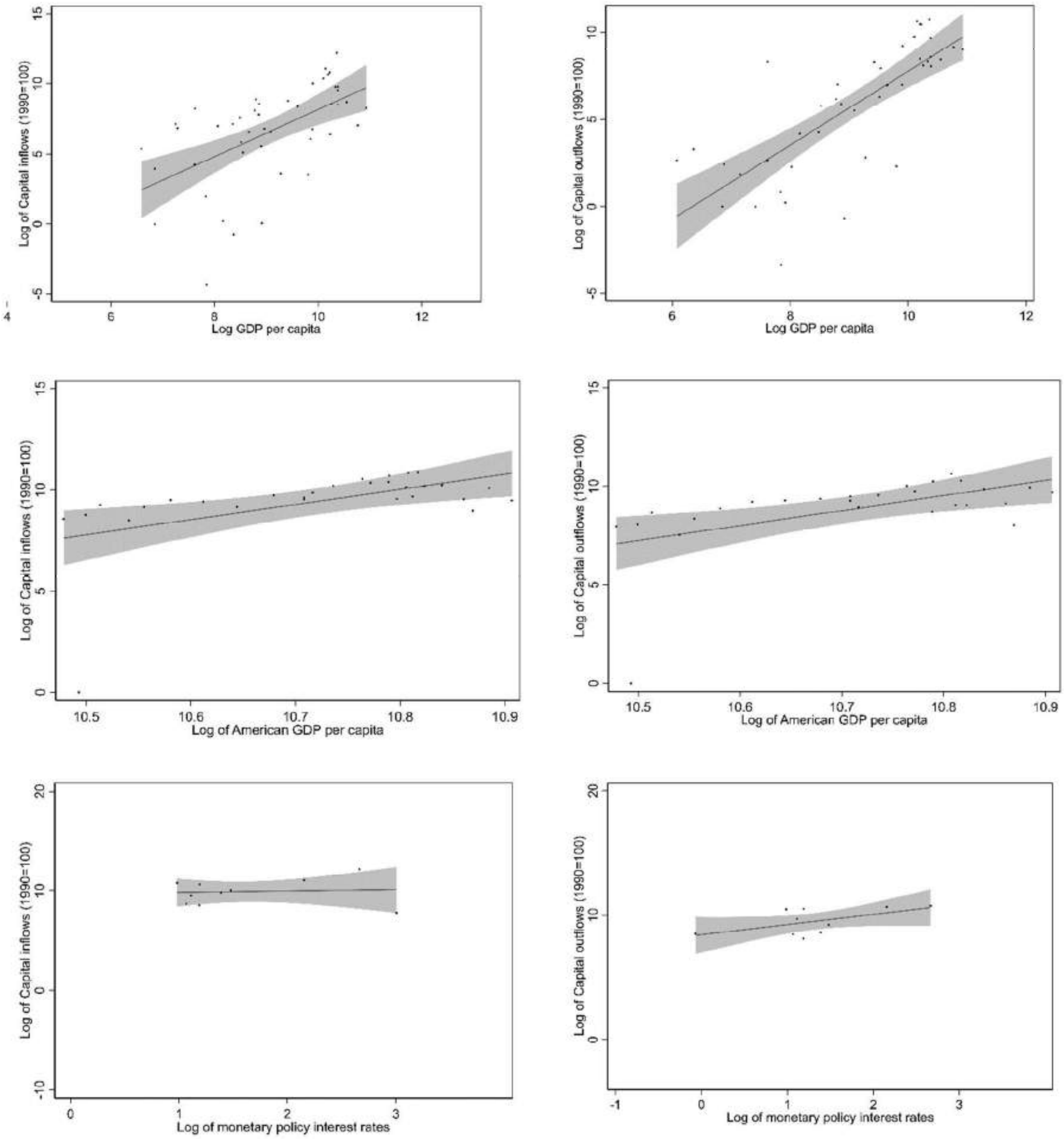
Variable	
US GDP per capita	45120.61
	(5350.08)
US monetary policy interest rate	2.78
	(1.93)
VIX	19.53
	(3.28)

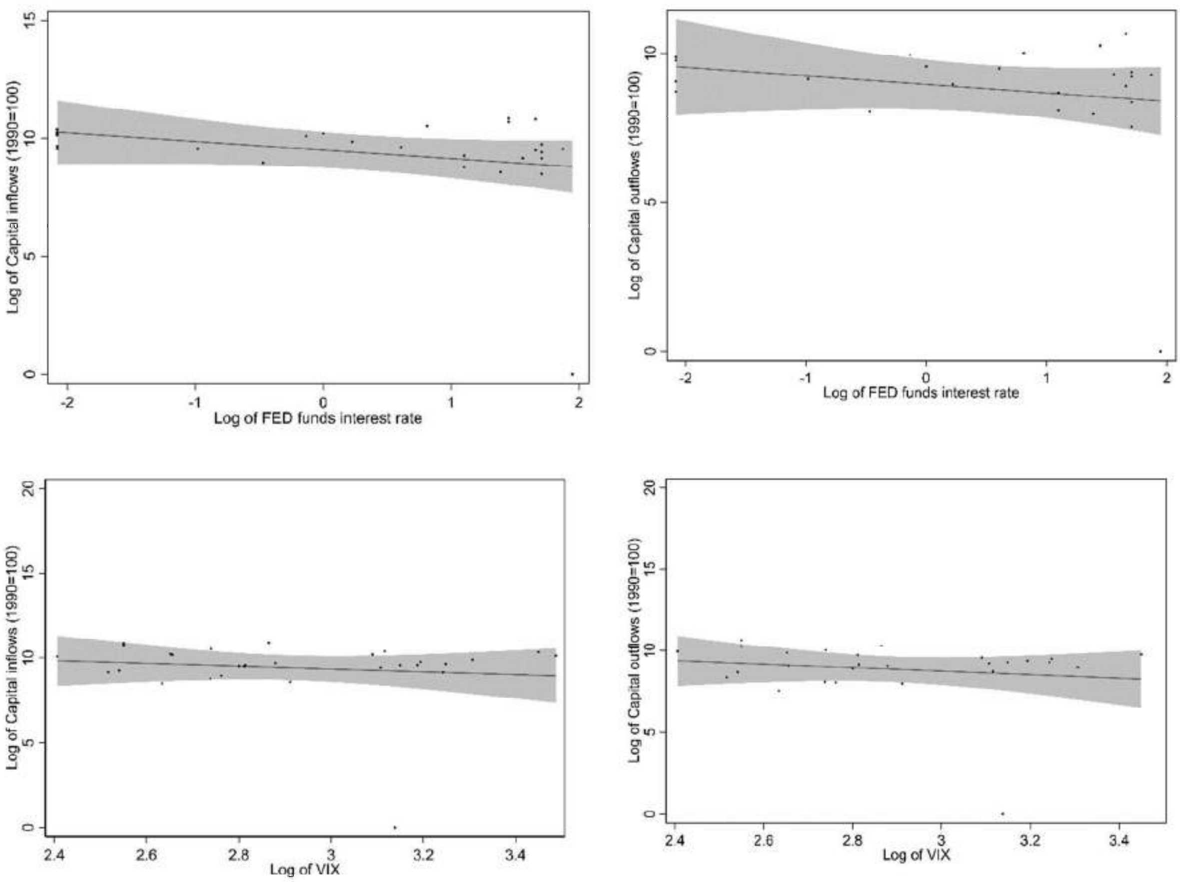
Note: Standard deviations are reported inside parentheses.

Unsurprisingly, American GDP per capita is higher than both means of AE and EME's GDP per capita. Also, the FED funds interest rate is relatively low (2.78%), especially when compared to other countries. Finally, the VIX for the period in analysis displays an average of just 19.53.

Following, **Figure 1** displays a scatter plot and a regression plot at the same figure, for all pairs of two dependent variables and the independent variables, except FX-volatility.

Figure 1 - Dependent and independent variables





Note: Author's elaboration.

Figure 1 displays the relationship between two dependent variables and five dependent variables (three pull variables and two push variables). Some behaviors emerge from these graphs, such as the linear relationship between two dependent variables and the independent variables. Besides, for some variables, such as GDP per capita, the linear relationship appears to be stronger than in other cases, which might be evidence of a pronounced importance of this variable in the modeling when compared to the other variables.

2.4.2– Model

Now, we present the short-run and long-run coefficients from the GMM-System estimation in **Table 4**. These estimates allow us to draw a direct comparison between our short-run and long-run coefficients, including a Wald test between the two coefficients for the same variable.

Table 4- Short-run and long-run coefficients of the capital inflows in the form of debt held by foreign agents

	Short-run GMM-System	Long-run GMM-System	Wald test of equality between short-run and long-run coefficients
Lag of capital inflows	0.603***	-	-
	(0.0402)		
PULL FACTORS			
GDP per capita	0.254***	0.639***	8.85
	(0.0852)	(0.208)	[0.003]
Monetary policy interest rates	7.500***	18.875***	5.98
	(2.675)	(7.178)	[0.015
FX-implied volatility	6.724	16.922	0.75
	(8.103)	(19.832)	[0.386]
PUSH FACTORS			
US GDP per capita	1.353	3.406141	1.90
	(0.946)	(2.420207)	[0.168]
US monetary policy interest rates	3672.0	9241.928	2.34
	(2303.8)	(5900.109)	[0.126]
VIX	436.0	1097.382	1.21
	(358.2)	(956.4398)	[0.271]

Source: Author's elaboration. The standard deviations are reported inside parentheses.

Note:

1- * p<0.1;** p<0.05; ***p<0.01.

2- In the Wald test, the chi-square statistic is reported directly in the line, with its p-value below inside brackets.

Now, we interpret the previous short-run coefficients considering the literature. The results of the OLS, Fixed-Effects, GMM-Difference, and GMM-System are presented in Appendix A.2. By **Table 4**, we have three significant coefficients, which are the autoregressive term, national GDP per capita, and monetary policy interest rates (both pull factors). The coefficient of the lagged dependent variable indicates some persistence of the behavior of the capital inflows in the format of debt held by foreign agents. Continuing our analysis, we have that an increase of 1 dollar in the national GDP per capita raises the national debt held by foreign agents by about 0.254 (US$254000). Regarding the coefficient of the interest rates, we have that an increase in 1 percentage point of this variable implies an increase in the national debt held by foreign agents in about 7.5 (in terms of dollars, this is about US$7.5 million). Finally, we have that both the Hansen test and AR(2) test have their null hypothesis non-rejected, which implies that our instruments are exogenous and the residuals of our model are not serially correlated (present in Appendix A.2).

In the long-run, both GDP per capita and monetary policy interest rates continue to be significant at 5%. Now, we have that an increase of 1 dollar in the national GDP per capita raises the national debt held by foreign agents by about 0.639848 (US$639848). As for the coefficient of the monetary policy interest rate, we have that an increase in 1 percentage point of this variable implies an increase in the national debt held by foreign agents in about 18.875 (in terms of dollars, this is about US$18.875 million). Those two significant coefficients of pull variables in the longer-run are in absolute terms higher than their parts in the short-run, validating somehow our expectation. Furthermore, the Wald test can determine whether the short- and long-run coefficients are statistically similar. By applying the Wald test on the short- and long-run coefficients, we conclude that short- and long-run coefficients differ only for the variables that were significant in the short-run, i.e. GDP per capita and monetary policy interest rates. Therefore, our results suggest that pull factors are more relevant at explaining capital inflows in the long-run than in the short-run. This is in line with the work of Koepke (2019) and adds to the literature by dissociating short- and long-run dynamics of pull and push factors over capital inflows. Furthermore, our results advance the results found by Hernández (2015) e Weiss and Prates (2017), which found push factors to be more relevant at explaining capital inflows than pull factors. In that way, our results evidence the relevance of considering time frames larger than the commonly used in the capital flows studies. This consideration can provide a more nuanced analysis of the impact of pull variables on capital inflows in time. They are no longer unimportant to capital flows; their time of impact is longer than that of the push factors.

Moreover, Byrne and Fiess (2011) also found the American monetary policy interest rates to be of a lesser importance in determining the capital inflows to EME, which corroborates the results displayed in the **Table 4**.

Next, we discuss the short- and long-run determinants of capital outflows. In **Table 5** we present the short-run and long-run coefficients for the capital outflows. The OLS, fixed-effects, GMM-Difference, and GMM-System results are presented in Appendix A.3.

Table 5- Short-run and long-run coefficients of the capital outflows in the form of debt held by foreign agents

	Short-run GMM-System	Long-run GMM-System	Wald test of equality between short-run and long-run coefficients
Lag of capital outflows	0.462**	-	-
	(0.178)		
PULL FACTORS			
GDP per capita	0.364***	0.676***	4.14
	(0.134)	(0.162)	[0.042]
Monetary policy interest rate	1.671	3.103	1.85
	(2.307)	(3.328)	[0.174]
FX-implied volatility	2.468	4.587	0.26
	(4.886)	(8.884)	[0.609
PUSH FACTORS			
US GDP per capita	2.043***	3.797***	2.42
	(0.748)	(1.399)	[0.119]
US monetary policy interest rate	5357.4***	9958.474***	2.23
	(1834.1)	(3767.171)	[0.1356]
VIX	-656.9***	-1221.155*	1.39
	(225.8)	(631.7197)	[0.2377]

Source: Author's elaboration. The standard deviations are reported inside parentheses.

Note:

1- * p<0.1;** p<0.05; ***p<0.01.

2- In the Wald test, the chi-square statistic is reported directly in the line, with its p-value below inside brackets.

Now, we interpret the short-run results in light of the literature on capital flows. The coefficient of the lagged dependent variable is significant, indicating a persistent behavior of the dependent variable, which is the capital outflows in terms of foreign debt, private and otherwise, owned by national agents. In this case, we confirm that most coefficients are significant, except for the national monetary policy interest rate and the volatility of FX, which suggests that pull factors are not very important in determining the capital outflows of a country. Now, we analyze the other significant coefficients. The variable of national GDP per capita is an important determinant of the capital outflows in the form of debt owned by nationals, with an increase of US$1 in this variable raising the capital outflows in the order of US$364000. This is in line with the expectation in the literature, given that the wealthier the country, more resources are available for diversifying investment, hence buying foreign assets. The US GDP per capita, in turn, also is significant in determining the capital outflows in terms of the debt held by nationals. In that way, an increase of US$ 1 in the US GDP per capita raises the capital outflows by more than US$2 million, which is also expected given the relevance of the US economy to the world output. Continuing our analysis, we have that the American monetary policy interest rates are the most important determinant of the capital outflows in our models, given that an increase of 1 percentage point in that variable is responsible for the expansion of more than US$5 billion in our dependent variable. There are several explanations for this effect. First, given that the US Treasury Bonds are probably the safest of their kind on the planet, interest rates hikes make them even more attractive to any investor. Besides, given its relevance, changes in the FED Funds Rate also tend to change the yield curves across the globe. This changes the world preference for liquidity, implying an increase of investment in illiquid assets across the globe, which need to at least match the American federal issued papers (if they are as safe as those assets). Now, we interpret the last significant coefficient, which is the VIX coefficient. An increase of unity of this index decreases the capital outflows in the form of debt held by national agents in more than US$650 million, which is in line with the literature. Given that the VIX is the implied risk of the S & P 500 equities, we expect that the higher the risk, the less prone to investing abroad national agents are. The importance of the VIX is in line with Weiss and Prates (2017) findings, which suggest that the risk structure in developed countries affects the risk-taking behavior of all investors. In terms of the tests for how fitting our models are, we have that both the Hansen test and AR(2) test have their null hypothesis non-rejected, which implies that our instruments are exogenous and the residuals of our model are not serially correlated (present in Appendix A.3).

In the long-run, the significant coefficients are those of the GDP per capita, USA GDP per capita, FED funds interest rates, and VIX. They all are higher in absolute value than their short-run parts. However, the Wald test indicates that only the GDP per capita long-run coefficient is statistically different from the short-run coefficient, evidencing again that the pull factors tend to become more relevant in determining capital inflows and outflows in the long-run. Interpreting the coefficient of GDP only, given it is the only statistically different from its short-run part, we have that an increase of US$1 in this variable raises the capital outflows in the order of US$676001. This is per the literature given that a higher GDP implies more available resources for investments, hence including abroad.Finally, in **Table 6**, we present a comparative table detailing whether a coefficient of a variable was significant (at 5%) or not in both short- and long-term for both capital inflows and outflows.

Table 6- Comparison of short- and long-run coefficients significance for both capital inflows and outflows

Variable	Capital Inflows			Capital Outflows		
	Short-term	Long-run	Are they statistically different?	Short-term	Long-term	Are they statistically different?
PULL FACTORS						
GDP per capita	Yes	Yes	Yes	Yes	Yes	Yes
Monetary policy interest rate	Yes	Yes	Yes	No	No	No
FX-implied volatility	No	No	No	No	No	No
PUSH FACTORS						
US GDP per capita	No	No	No	Yes	Yes	No
US monetary policy interest rate	No	No	No	Yes	Yes	No
VIX	No	No	No	Yes	No	No

Note: Author's elaboration.

The previous **Table 6** is a brief and synthetic comparison between the short and long-run coefficients in both capital inflows and outflows. Again, we emphasize the behavior of pull variables, which tended to display a larger impact on flows in the long-term than in the short-term, being evidence that indeed there are important time differences in the way determinants of capital flows affect these flows across different periods. The econometric evidence for this difference in the short- and long-run dynamics of capital flows is our main contribution to the literature.

2.5 – Final Remarks

This chapter aimed at evaluating how the usual explicative variables affect capital flows in a distinct time horizon of analysis. By deploying GMM-System, we estimated the short- and long-run relationships between the capital flows, in the form of debt, and their push and pull determinants, for about 90 countries. The results are in line with the expected. We found that pull factors, which are GDP per capita, interest rates, and the implied volatility of FX of country, are relevant at explaining the capital flows in the short-run, with their higher influence in the long-run. At the same time, push factors, which are both American GDP and interest rates, and VIX, are relevant at explaining the capital flows in the short-run, becoming less important as we move to the long-run. These results are novel in terms of the literature of capital flows, as works with regards for capital flows tend to find that push factors have a larger impact on capital flows when compared to pull factors. Hence, this work brings a new perspective to the debate by postulating different relevance of pull factors depending on the time of analysis.We also innovated by implementing a common methodology, GMM-System, that allowed us to evaluate our short- and long-run coefficients and even compare them.

Future venues of research might be interested in applying the GMM-System methodology to disaggregated capital flows data, i.e., more granular data of capital flows, such as those coming directly from banks of investments and other financial agents. Furthermore, considering flows at their country's currency might explain some other relationship of the interaction of pull/push factors and the exchange rates.

Chapter 3 - Monetary policy impact on the bank-municipality level: a crossed approach

3.1 – Introduction

Scott (1955) was one of the first researchers to study the differences among regions in terms of the impact of monetary policy, analyzing the impact of New York monetary policy on the whole United States. Ever since, many studies have been conducted for several countries and regions (in different level of aggregations) using different methods, ranging from time series methods to panel methods and spatial econometric methods (ARNOLD; VRUGT, 2002; BERTANHA *et al.*, 2006; CROCCO *et al.*, 2010; DUTRA; DO VALLE FEIJÓ; BASTOS, 2017; FRASER; MACDONALD; MULLINEUX, 2014).

Regional differences in the impact of monetary policy on real variable (even in the short-run as new Keynesians postulate) seem to be relevant. If the monetary authority considers the space to be neutral in terms of the policy when designing the instruments of its action in the economy, the efficiency of the monetary policy may be compromised. In that way, ignoring the economic aspect of each region may harm the monetary authority's ability to reach its monetary targets.

The spatialization of the monetary policy should be analyzed in light of the modern theories of the relationship between space and economic policy. In that way, Dow and Montagnoli (2007), for example, analyze the channels by which the monetary policy may affect real variables. They postulate the existence of three channels, which are: banking lending channel, the borrowing channel, and the expectations/confidence channel. These channels change the impact of monetary policy across regions, with wealthier regions being less susceptible to the adverse effects of a contractionary policy, while poorer regions fare worse in this regard, being disproportiantely affected by this same kind of contractionary policy.

Other works such as Nogueira *et al.* (2009) e Crocco *et al.* (2010) study the relationship between credit and monetary policy in light of central place theory and the spatialization of monetary policy. These two studies found that the centrality of a region indeed affects how prone the region is to negative effects caused by a contractionary policy. Nogueira *et al.* (2009), for instance, find that there are differences in the loans made by banks branches in wealthier and poorer regions, with the former attracting more banking credit than the latter. Crocco *et al.* (2010), in turn, find that there is a spatial concentration of bank branches in terms of credit, that is, banks branches that lend a high volume of credit tend to be surrounded by bank branches that lend a lower volume of credit

The present chapter aims at analyzing the impact of national short-term interest rates (SELIC) changes on variables concerning credit operations and medium-to-long-term deposits (time deposits) by different levels of aggregation of banking institution-municipality. We accomplish that by implementing first a Bayesian crossed model and a spatial panel model (as robustness checks) on banking data collected from the consolidated balance sheets (Estatísticas Bancárias – ESTBAN from Brazilian Central Bank) of banks in a municipality. The use of Bayesian crossed models for this analysis on the efficiency of monetary policy is novel, to the best of our knowledge. These models tend to be used more thoroughly in Biology and Education, but we make a case of its relevance at analyzing the impact of monetary policy on specific variables within an institutional and municipal framing as relevant and novel.

Besides this introduction, the remainder of this chapter is organized into Literature Review, Methodology, Results, and Final Remarks.

3.2 – Literature Review

The aim of this section is twofold, namely contextualizing the theory behind the impact of monetary policy on credit, in a regional setting, and reviewing empirical studies in the regional impact of monetary policy. In theoretical terms, two phenomena are crucial to understanding the aims of this chapter: the finance-investment-saving-funding paradigm set forth by Keynes and the channels of monetary policy, especially the credit channel.

In the finance-funding paradigm, the economy works with two main assumptions: expenditures of any nature come prior to savings/taxes and the Keynesian multiplier is greater than unity. Based on these two assumptions, the way an investment is implemented is by firms which borrow from banks (this phase is known as finance), then capital is immobilized (investment), which then generates cash flows, which is partly used to pay a firm's debt and partly saved up (savings). These savings then go again to the banking system (funding), which restarts the cycle with the finance again. By and large, this is the movement of the flows in the finance-investment-saving-funding-circuit. It is relevant to say that in the investment phase the resources enter the Keynesian multiplier mechanism because this money is directed to capital goods firms, which amplify the impact of the finance in the economy (BARBOSA, ALENCAR e DINIZ, 2016).

In a regional setting, the finance-funding paradigm can be more tuned for one region than another, which then may create differences in the way regions respond to monetary policy. For instance, poorer (or peripheral) regions tend to be more impacted by a contractionary policy than wealthier (or central) regions. That is explained partly by the fact that wealthier regions rely on a more diverse set of investment sources, hence diluting the influence of the monetary authority in affecting the economy by usual monetary policy instruments.

In terms of how monetary policies affect the economy, Silva (2011) analyzes the usual five channels, which are: interest rates, exchange rates, credit, asset prices, and expectations. We briefly discuss each of these channels, with the focus on the credit channel. The interest rates channel of the monetary policy is related to the influence of the monetary policy interest rates in the whole interest rates curve. Thus, a contractionary monetary policy is capable of moving upwards the whole interest rate structure in the economy. This, of course, prompts difficulty for the private investment to maintain its current levels, forcing new decisions of investments at a lower level than the current one. The exchange rates channel is related to the fact that a contractionary monetary policy makes the national currency more desirable to foreign investors, thus causing an appreciation of the national currency. This has the real impact of a leak of internal demand, as importations become cheaper in the national currency (ceteris paribus their prices in the international currency). The asset price channel is related to the worthiness of the government-issued bonds. Given a contractionary monetary policy, public bonds become more desirable than other assets in the economy, which then deflates the prices of these assets, that is, firms and consumers' assets. The real consequences of this deflation in the price of assets is mostly a lower investment (caused by a lower prospect of profit) and diminishing collateral for large investments. The expectational channel is also very important. When a monetary authority changes the interest rate target, in an expected or unexpected manner, many signs are displayed by this action. In this way, with an expected contractionary monetary policy, agents tend to absorb this change in terms of prices and believe in the communication channel economic agents have with the monetary authority. Opposite to this, an unexpected contractionary monetary policy sends different and contradictory signs, such as a distrustful monetary authority, with a multitude of objectives. This last aspect is relevant in understanding modern monetary authority action in several moments. Recently, monetary authorities usually make their mandate public, that is, the objectives they aim at reaching by deploying modern monetary policy apparatus are formally communicated to the public.

Finally, the last channel is the credit channel, which was thoroughly analyzed by Bernanke and Gertler (1995). Roughly speaking the credit channel can be further divided into two other categories, which are the usual balance sheet channel and the banking channel. The balance sheet channel is related to the fact that an increase in the interest rate affects a firm's balance sheets in two ways: it puts more stress on loan payments, given higher interest rate, and also devaluates a firm's assets, by the asset prices channel. In this way, a contractionary monetary policy affects the creditworthiness of a firm, implying a lower credit lent to her in the economy. This individual effect when summed up over the entire economy has the ability to reduce credit in the economy and reduces both firm's investment and profit prospects, while it also affects banks' profits. The banking channel consists in the higher interest rates banks begin requiring for loans, given a contractionary monetary policy. In that way, not only their borrowers' creditworthiness change, but also the interest rates they require for loans tend to increase.

In terms of the present chapter, the credit channel is the channel which we are most interested, by understanding how the Brazilian monetary policy affect the credit and liabilities' liquidity at the level of bank-municipality. In that way, we expect a negative causal relationship between Brazilian monetary policy interest rates (SELIC) and our measures of credit and liabilities' liquidity at the bank-municipality level. With the monetary policy aspect appropriately discussed, the next theoretical important link we still have to draw in this work is the spatialization of the monetary policy in terms of its impacts, which should be accounted for by one or more of the channels previously explained.

The spatialization of the impact of monetary policies is analyzed under several methods and theoretical approaches. Dow and Montagnoli (2007) postulates that there are three channels for the regional transmission of the monetary policy to the regions. Those three channels are banking lending channels (intra-regional differences between banks and also more funds available in core regions), borrowing channel (related to the borrower, with core regions beings characterized by possessing wealthier clients than peripheral regions), and expectations/confidence channel (risk is more understood in core regions than in peripheral regions). In that way, monetary policy should not affect regions equally, given the difference among them.

Fraser, Macdonald, and Mullineux (2014), in turn, analyze the impact of interest rates, commodities prices, among others, on variables related to the GDP. By deploying Structural Vector Auto-Regressive (SVAR) on data from 1986 to 2008, the authors find regional differences with the effect of monetary policy on economic variables, with poorer states being the most affected, while wealthier states were not the most affected (as they were more in line with the movements of the national economy). For Brazil, Bertanha and Haddad (2006) study, using a spatial VAR, the impacts of monetary policy on employment in the period 1995-2005.

The authors use three weight matrixes (trade-weighted, queen, and no spatial weights) and they find that spatial effects tend to concentrate the impact of monetary policy in Brazil, while using a non-spatial weight matrix tends to disperse the effect of monetary policy on employment, leaving a thinner impact in the space. For Netherlands, Arnold and Vrugt (2002) study the impact of monetary policy on combinations of sectors-regions, using a VAR spanning the period 1973 and 1993. They find evidence of a different regional effect of monetary policy per region and evidence that this impact is also correlated to the sector composition of the economic activities of each region. For example, the oil and gas sector has exhibited an increase of production, given a hike in interest rates, which goes against the impact of other sectors for the same shock in monetary policy.

Other works usually study a relevant concept with Keynesian inspiration: liquidity preference, which can be roughly described as the preference for liquid assets by economic agents. This preference is necessarily constant neither for the same set of agents nor in time. As a proxy for the liquidity preference, a candidate index consists of Demand Deposits/Total Deposits (DD/TD) ratio, with higher values indicating a preference of the public (it can also be banks) for most liquid assets. A higher liquidity preference reduces a bank's ability to lend when compared to a lower value of liquidity preference by the public and it is also linked to more uncertain investment and consumption decisions. The following studies use this concept in some manner. Dutra, Feijó, and Bastos (2017), using VAR on ESTBAN[3] data, analyze the impact of monetary policy on liquidity preference and credit provision (a proxy for uncertainty) by Brazilian regions, spanning January 2003 and December 2012. Their conclusions are in line with post-Keynesian theory, with less developed regions being more susceptible to the shocks of monetary policies.

In terms of panel methods, the following works are important for Brazilian evidence of the regional impact of monetary policies. Initially, Cavalcante *et al.* (2004) analyze how public and banks liquidity preference are distributed spatially. Based on Brazilian Central Bank data, the authors conclude that wealthier regions indeed present a lower liquidity preference of both public and banks, as expected, while poorer regions show higher values for those two indexes. Next, Crocco *et al.* (2010) bridge theoretically the post-Keynesian ideas of monetary policy with the central place theory. The authors use ESTBAN data (from the Brazilian Central Bank)

[3] ESTBAN, meaning banking statistics, consist of consolidated and simplified banking statistics released monthly by the Brazilian Central Bank. They are released in two levels of analysis, which are the bank-municipal level, which we use in this work, and the bank branch-municipal level.

and deploy spatial econometrics methods. Crocco *et al.* (2010) find that there is indeed a spatial concentration of banks, that is, banks branches that lend a high volume of credit tend to be surrounded by bank branches that lend a lower volume of credit. Crocco *et al.* (2011), in turn, analyze the credit gap, that is, the difference between the credit and expected credit for a region, given its GDP size relative to national GDP. Using panel methods, they find most results are aligned with the hypothesis of credit rationing, with the size of deposits contributing negatively to the credit gap, while population size also affects this gap positively (in the linear term) and negatively (in the square term).

Nogueira *et al.* (2009) work with principal component analysis and cluster analysis under the center-periphery theory in order to study whether or not there are differences between bank branches' actions in wealthier and poorer regions for Brazil. The authors find that in wealthier states, such as those in the South and Southeast regions, bank branches lend more when compared to the whole country. Poorer states, in turn, suffer from a lack of banking activity, given that loans in these states are lower and the volume is also much lower than that of wealthier states.

Carvalho, Pereira, and Shiki (2020), in turn, analyze the impact of monetary policy on credit for the Brazilian Southeast region. By using ESTBAN data, from 2002 to 2012, and dynamic panel methods, the authors find that a SELIC increase affects credit differently depending on whether a region is part of the center or periphery. In that way, the credit in peripheral regions is more negatively affected following a SELIC hike than the credit in central regions. Analogously, a SELIC reduction also positively affects more the credit in those peripherical regions than in central regions.

Finally, Pizzuto (2020) analyzes the evidence for differences in the impact of monetary policy in US regions, by deploying a narrative approach to unexpected monetary policies changes (usually represented by unexpected changes in the FED funds rates), alongside a spatialized approach through the spatial weight matrix. The author concludes that there is evidence for the interest rate and housing market channel, whereas there is no evidence for a credit channel in the heterogeneous effects of monetary policy on the American regions.

3.3 - Methodology

The last section review served the purpose of eliciting two perceptions: the space matters for the monetary policy and the credit channel tends to be more important at capturing the effect of interest rates changes in the credit as lent by banks. In that way, our theoretical expectation following a SELIC change is an immediate change in the amount of loans made by banks and deposits by the public. This expectation comes from the analysis of the two channels of monetary at play in the case of change in the interest rates: credit and prices. In that way, an increase in the interest rates implies a reduction of the credit available in the economy, given that banks now tend to lend with higher interest rates payment. At the same time, by the prices channel of monetary policy, assets' prices tend to fall, decreasing prospects of profit and companies' collateral available for borrowing credit from banks. Hence, this change in the interest rates also affect deposits, decreasing them given a contractionary monetary policy Moreover, these movements are not spatially neutral, that is, how banks and public respond to changes in the interest rates is spatial-dependent. For instance, wealthier regions tend to rely on a more diverse set of financing options than poorer regions, which makes them less affected by a contractionary monetary policy, that is, there is a leak in the monetary policy channel described previously in wealthier regions.

Given this perception of the problem at hand, two methods are used in this work to analyze the regional impact of monetary policy on credit and medium-to-long-term deposits (time deposits), which are crossed models and spatial panel methods. Before detailing these methods, we briefly explain the variables used in these models.

3.3.1 - Variables and their sources

The dependent variables consist of two indexes calculated from the ESTBAN data from the Brazilian Central Bank. They are Time Deposits/Total Deposits, which proxies for the ability of a bank branch to convert liabilities maturity into medium-to-long term liabilities (become less susceptible to asset-liabilities mismatch), and Time Deposits/Loans and discounted debts (credit operations henceforth), which proxies for the capacity of a bank branch to equate the maturity of their long term assets and liabilities, that is, it is a proxy for local branch capacity to increase credit facilities, while also extending the maturity of its liabilities.

Both dependent variables are related to the liquidity of banking institution at the level of a municipality. Moreover, they serve the purpose of analyzing the liquidity from two different optics. The Time Deposits-Total Deposits ratio is a way to gauge how banks are balancing their liabilities in different times of maturity. Banks basically ease the transfer of assets of different maturities among economic agents, hence their role demands an active management of this liquidity index. High values of the Time Deposits-Total Deposits ratio indicate therefore a higher capacity of a bank to manage the maturities of their deposits. The Time Deposits-Credit

Operations ratio, on the other hand, is way to gauge how banks are balancing their medium-to-long term liabilities while also improving the credit facilities.

With these two dependent variables, we expect to capture the impact of SELIC changes in the credit and liabilities' liquidity measures (Time Deposits-Credit Operations ratio and Time Deposits-Total Deposits ratio, respectively). We expect a negative relationship between SELIC and these two measures, while also allowing for possible differences in these relationships among the Brazilian administrative regions.

The monetary policy is also analyzed by two other variables, which are the adapted reserve requirements and a dummy for a tightening in capital requirements. By considering these two other variables, we expect to comprehend better the impact of monetary policy on the liquidity of banking institutions as captured by the two dependent variables.

The independent variables are the following: SELIC (Brazilian Central Bank funds rate), Reserve requirements (adapted per branch), capital requirements (dummy for tightening), the average of formal workforce wages by municipality, and year (starting with 0 in 2000). Moreover, three dummies are also included in the model, which are: whether or not the bank branch is public, whether or not the municipality, where the bank branch is located, is a state capital, and whether or not the bank branch is not a Top 5 bank (in terms of the size their assets). The following **Table 7** explains the variables and their sources.

Table 7 - Variables and their sources

Variables	Description	Source
Public response	Time Deposits/Total Deposits	Author's elaboration from ESTBAN (Brazilian Central Bank)
Banking response	Time Deposits/ Loans and discounted debts	Author's elaboration from ESTBAN (Brazilian Central Bank)
$Year_{ij(kl)}$	Year (2000-2016), recoded to start from 0	Author' elaboration
$Wages_{..(il)}$	Mean of formal workforce wages in each municipality	Author's elaboration from RAIS, Ministry of Labor

Adapted RR	Reserve requirements proxy[4]	Author's elaboration from the Brazilian Central Bank
Capital_Requirements..(..)	Capital requirements change for banks. This dummy assumes the value of 1 for tightening and 0 otherwise.	Alam *et al.* (2019)
SELIC..(..)	SELIC interest rates for short-term loans	IPEA, from Brazilian Central Bank
NTOP5..(..)	Dummy for whether or not a bank institution does not belong to the TOP 5 institutions, according to their assets, as in 2019.	Author's elaboration, based on Valor Econômico's ranking of banks.
Capitals	Dummy for whether a municipality is a state capital or not	IBGE (2020)
Public..(..)	Dummy for whether a bank institution is at least partially government-owned or not.	Brazilian Central Bank (2020)

Note: Author's elaboration.

3.3.2 – Bayesian crossed models

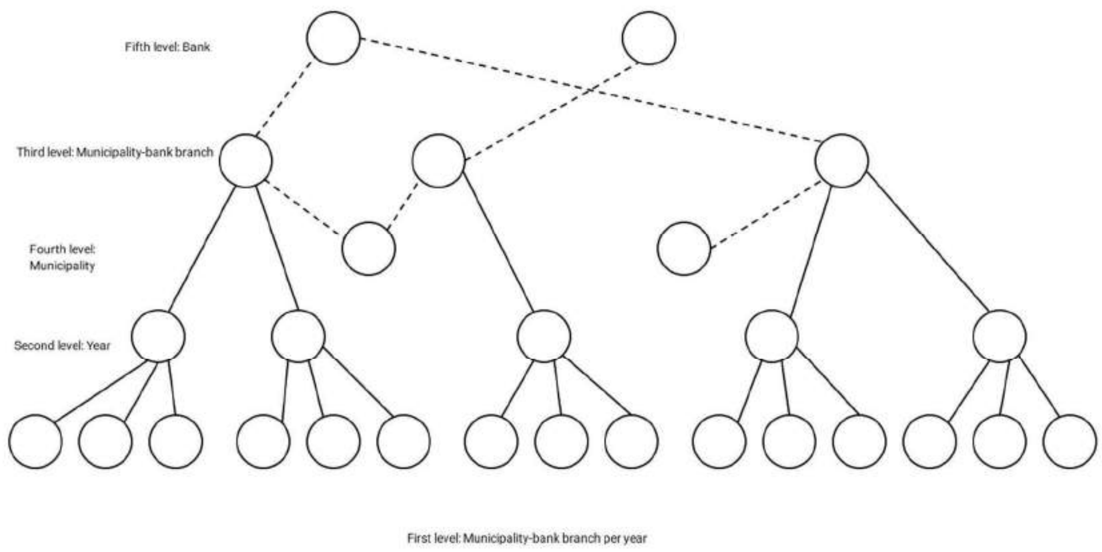
In this chapter, the main methodology consists of crossed models. These models are a generalization of hierarchical mixed models. In the latter models, data is usually nested within levels. Crossed models, in turn, do not require nested data, but crossed data, that is, lower levels belong to categories in each level that are not necessarily nested within each other. For instance, a purely hierarchical structure of banking data could be seen as bank branches nested within banks. This chapter's innovation consists in making this requirement of nesting flexible, by also considering the municipal reality in which each bank branch is inserted. In that way, a bank branch belongs to bank A and it is located inside municipality B. Logically, neither all banks A is located in municipality B, nor all B is a component of banks A. That crossed design motivates the analysis of crossed mixed models, instead of a hierarchical model. In that way, the crossed

[4] It was calculated by the following quotient: (Total Deposits-Savings)/mean(Reserves), where mean(Reserves) is an average of the account 113 from ESTBAN across the branches that belong to the same bank.

models allow us to consider both the banking and the spatial reality of the activities of banks in a municipality. Hierarchical models, on the other hand, would restrict our modelling by requiring a choice of considering either the bank aspect or the spatial aspect, that is, they are more rigid at modelling than the crossed models. In that way, the generality[5] of the crossed models is greater than hierarchical models, allowing us to capture the similarities and differences among banks and municipalities in terms of the dependent variables.

The following **Figure 2** synthesizes the crossed and nested character of the ESTBAN data, with the continuous line indicating a nesting structure among the levels, while the discretized line indicates a crossing nature among the levels.

Figure 2 - Diagram of Crossed Design of the banking system



Source: Author's elaboration.

The first level is comprised of the municipality-bank combination in a single year. The second level, which nests the first one, consists of the years. The third level consists of each pair of municipality-bank present in the analysis. The fourth level consists of all municipalities present in the analysis, which contains the third level. The fifth level, crossed with the fourth level, consists of the banking institutions, which also nests the third level.

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[5] A simple fixed-effect model may also be used for the data at hand, however the fixed-effects model could not provide an answer regarding the relevance of the spatial (municipal) and the institutional levels at accounting for the error term in our modelling. In that way, the crossed model, contrary to the fixed-effects model, allows for a simple and effective way to analyze the source of the error term, explaining whether it comes from spatial characteristics of the municipalities where an observation is located or it comes from an institutional aspect of the bank.

Crossed models may possess complex and numerous structures of fixed and random effects, and variance components, which makes their frequentist estimation an impossibility, due to time constraints and convergence problems. Bayesian estimation (or more accurately model sampling) is therefore used in this chapter to circumvent these difficulties. We explain the main characteristics of the Bayesian methods used in this chapter in the following paragraphs.

Initially, it is interesting to motivate one key difference between the frequentist and Bayesian approaches. While the former considers data to be endogenously given and the parameters as fixed entities, characterized by some statistical quantities, the latter approach considers data to be exogenously given and parameters to be random. Hence, in Bayesian statistics, estimations are not just some points to which an optimization algorithm takes the process, but a whole distribution (the posterior) calculated based on data and priors distribution. The posterior distribution is the aim of estimation in Bayesian methods given that it may be a good description of the reality using all available information.

In the present case, the equation to be estimated through Bayesian methods is the following **Equation (3).**

$$Y_{ijk(lm)} \sim N(XB, \Omega)$$

$$\begin{aligned} Y_{ijk(lm)} = {} & \beta_{0.jk(lm)} + \beta_1 * \text{ SELIC}_{.....} + \beta_2 * \text{Capitalrequirements}_{.....} + \beta_3 \\ & * \text{AdaptedReserveRequirement}s_{..\,k(..)} + \beta_4 * \text{Ntop5}_{...(l.)} + \beta_5 \\ & * \text{public}_{...(l.)} + \beta_6 * \text{statecapitals}_{...(.m)} + \beta_7 * \text{wages}_{...(.m)} \end{aligned} \tag{3}$$

$$\begin{aligned} \beta_{0ijk(lm)} = {} & \beta_0 + u_{0,ban} + u_{0,municipali} + u_{0,bank-municipality} + u_{0,yea} \\ & + e_{0ijk(lm)} \end{aligned}$$

Where $Y_{ijk(lm)}$ is the dependent variable (already linearized), $SELIC$ is the SELIC interest rates, $Capitalrequirements$ is the dummy for capital requirements tightening in a given year, $AdaptedReserveRequirements_{...k(..)}$ is the adapted reserve requirements, $Ntop5_{...(l.)}$ is a dummy for whether a bank is not a TOP 5 bank or not, $public_{...(l.)}$ is a dummy for whether a bank is public or not, $statecapitals_{...(.m)}$ is a dummy for whether the municipality of a bank's branch is a state capital or not, and $wages_{...(.m)}$ is the municipal average of the formal workforce wages. The index ijk(lm) indicates that the lower three levels (ijk) are nested within the two crossed levels (lm) – banking institution and municipality, with i corresponding to each observation, j corresponding to the year, k corresponding to each pair of municipality-banking present in the data, l corresponding to banks, and m corresponding to the municipalities.

In more concrete terms, the Bayesian estimation[6] consists of the use of the relation: $\text{Posterior} \propto Likelihood * Priors$, where $\propto$ means that the right side is proportional to the left side.

One key aspect of the Bayesian statistics is the continuous iteration of the relation $\text{Posterior} \propto Likelihood * Priors$. First, the researcher postulates a prior for all the parameters of the model associated with a likelihood of the data. The first iteration updates the posterior. In the second iteration, the priors are updated with the posterior of the first iteration. This process of iterations works by two phases: burn-in (selection and updating the best priors for the analysis) and the iterations properly said (that is, after the burn-in all priors are updated continually). In this process, convergence is not guaranteed by the estimator (we do not have an estimator in the proper sense here), but the researcher needs to guarantee a proper number of executions of the burn-in phase and the iterations. In this work, we postulate 5000 iterations for the burn-in phase and 10000 for the iterations phase in the Bayesian procedure. This procedure is called MCMC (Monte Carlo Markov Chain). The name Monte Carlo is justified given that for the construction and update of the posterior, we draw samples from the distribution of the error term in the model. The Markov Chain is related to the fact that the values of an iteration are not independent of the past iterations. This is naturally explained by the fact that a past value of iteration is used as the prior for the following iteration[7]. As for the priors, we assume the priors of the non-crossed model equivalent to the crossed model, as a good guess for the burning-in values for the crossed models. Furthermore, to be conservative, the variance is assumed to be of the highest and very unlikely order (10^5), which makes the MCMC process more robust to different kinds of posteriors[8] (BROWNE *et al.*, 2009).

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[6] Bayesian statistics is not concerned in the estimation of fixed entities as much as drawing from the true posterior, which allows for a larger description than merely the mean and standard deviation (a full distribution is simulated). For synthesis, we use only the mean as the coefficient of interest, but a median is also commonly used as a description for the posterior.

[7] A convergence criterion for the MCMC consists into looking at the Auto-Correlation Function (ACF) and Partial Auto-correlation Function (PACF). Convergence of the estimation will manifest by the fact that series of values for a parameter display a stationary behavior in terms of the iterations. This is much more likely to happen the larger the number of iterations in the burn-in phase and the iterations phase afterwards.

[8] The priors regarding the coefficient parameters have the mean of the nested model, that is, we use the hierarchical model as a guess for drawing the posterior (which is used by MLWin implementation of these models). The variance of the coefficient has a prior of c^2, where c is a high value in terms of the coefficient β. The prior for scalar variances is given by $\Gamma(\epsilon, \epsilon)$, where ϵ is very small. For variance matrices, we have that the prior is

In terms of inference, instead of the confidence intervals used in the frequentist approach to statistics, in the Bayesian analysis, we have credible intervals. Bilateral credible intervals of a $\alpha\%$ are marked by values above the $\frac{\alpha}{2}\%$ percentile and below $(100-\frac{\alpha}{2})\%$ percentile. In terms of the interpretation, instead of the repetition of the same experiment over time, a la frequentist approach, a credible interval of $\alpha\%$ indicates that there is $(100-\alpha)\%$ of chance that the true value of the parameter (that is, mean of the parameter) of interest lies within the bound given by $(\frac{\alpha}{2}\%, (100-\frac{\alpha}{2})\%)$ percentiles.

3.3.3 – Spatial panel models

Spatial econometrics methods can also account for the spatial and institutional realities of bank distributed in space. In that way, spatial panel models can be used to also analyze by other optics the regional effect of monetary policy on banks, similar to that used in Bayesian crossed models. However, there is one critical difference in the way Bayesian crossed models and spatial panel models will deal with the error term. While the former considers error in a crossed and random fashion, the latter will consider some deterministic regularities in the dependent variable (possibly also in independent variables). In that way, the model estimated uses the following **Equation (4)**.

$$\begin{aligned} Y_{ijklm} = {} & \beta_0 + \beta_1 * SELIC_{.....} + \beta_2 * Capitalrequirements_{.....} + \beta_3 \\ & * AdaptedReserveRequirements_{..k..} + \beta_4 * Ntop5_{...l.} + \beta_5 \\ & * public_{...l.} + \beta_6 * statecapitals_{....m} + \beta_7 * wages_{....m} + \beta_8 * W \\ & * Y_{ijklm} + e_{0ijklm} \end{aligned} \tag{4}$$

$$\epsilon_{0ijklm} = \theta * W * \epsilon_{0ijklm} + u_t$$

The new variables when compared to the Bayesian crossed model consists of the W*Y, which is the spatially lagged dependent variable, and θ, which is the auto-regressive term of the error[9]. W is the spatial weight matrix. In this work, given the non-contiguity of data, we opt to use an 8-nearest neighbor weight matrix, following Crocco *et al.* (2010). One advantage of spatial panel modeling is the fact that it allows for some spatial determinism to be considered in the model. In that way, we, motivated by the literature, consider the possible impact of the

$p(\Omega^{-1}) = \text{Wishart}_p(p, p\hat{}_\Omega)$, where p is the number of rows in the variance matrix and $\hat{}_\Omega$ is an estimate for the true value of Ω. This estimate can be defined by the estimate of again the hierarchical model, without considering for the crossed design, that is, $\hat{}_\Omega$ is an informative prior for Ω.

[9] The spatially lagged dependent variable and the spatially legged error term might assume the same sign or the opposite sign. In the former case, the observable and non-observable characteristics of a observation's neighbors affect said observation in the same way, while in the latter case the opposite occurs, that is, the neighbors' observable characteristics affect an observation in a different manner from its non-observable characteristics.

dependent variable value assumed by 8 neighbors in determining the current value of our dependent variable for a bank in a determined municipality. The use of neighbor spatial weight matrix is also explained by the non-contiguity of the data, that is, the observations in our model do not occupy each a single polygon. In that way, distance spatial matrix, as it is the case of neighbor spatial weight matrix, are more commonly used. Furthermore, as Elhorst (2014), we use the random-effects model, due to three aspects of these models: first, it allows for the cross-sectional aspect of the data to be considered in the analysis (contrary to fixed effects, which by transformation eliminates the cross-sectional dimension of the data); second, the random-effects model does not consume the same degrees of freedom as the fixed effects (degrees of freedom are used indirectly in the fixed effects' estimation); third, it avoids the problem of non-estimation of time-invariant variables.

The spatial analysis presents a further issue in terms of analyzing its coefficient. As Elhorst (2014) mentions, there is a wide range of possible models that allow for neighbor's values of the dependent variable, the independent variable(s), and the error term to affect the local realizations of the dependent variable. This must be accounted for when analyzing the coefficients. For instance, with a spatially lagged-independent variable, changes in this variable do not only affect the local observation but also those observations, whose local observation is a neighbor. Naturally, this effect is an infinite series that converges to a finite sum in well-behaved cases. Based on these concepts, there is the possibility, which allows for a correct interpretation, of calculating direct, indirect, and total effects of the independent variables on the dependent variable. The direct effects are naturally the direct effect of the variation of an independent variable on the dependent variable. The indirect effects are the sum of indirect effects of an independent variable on the dependent variable, through the interactions of the local observation and its neighbors (a spill-over effect). The total effects, which we focus our analysis, are the sum of the direct and indirect effects. In that way, the total effects correctly account for the direct and indirect effects and they are more thoroughly analyzed. Besides these effects, the sign of the spatially lagged dependent variable and error also present interesting information, such as spatial concentration (or the dispersion) of the dependent variable. Hence, they are also analyzed.

3.4 – Results

3.4.1 – Descriptive Statistics

In this section, we describe the data used in this analysis. It consists of 76653 observations, which are divided into 5 regions, with the following distribution: Northern region with 3451 observations, Northeast region with 15963, Mid-west region with 7157, Southeast region with 30923, and Southern region with 19159. We display the mean and standard deviations of all dependent and independent variables in **Table 8**. Afterwards, we show three maps that display the municipal mean of wages and the dependent variables.

Table 8 - Descriptive Statistics of dependent and independent variables

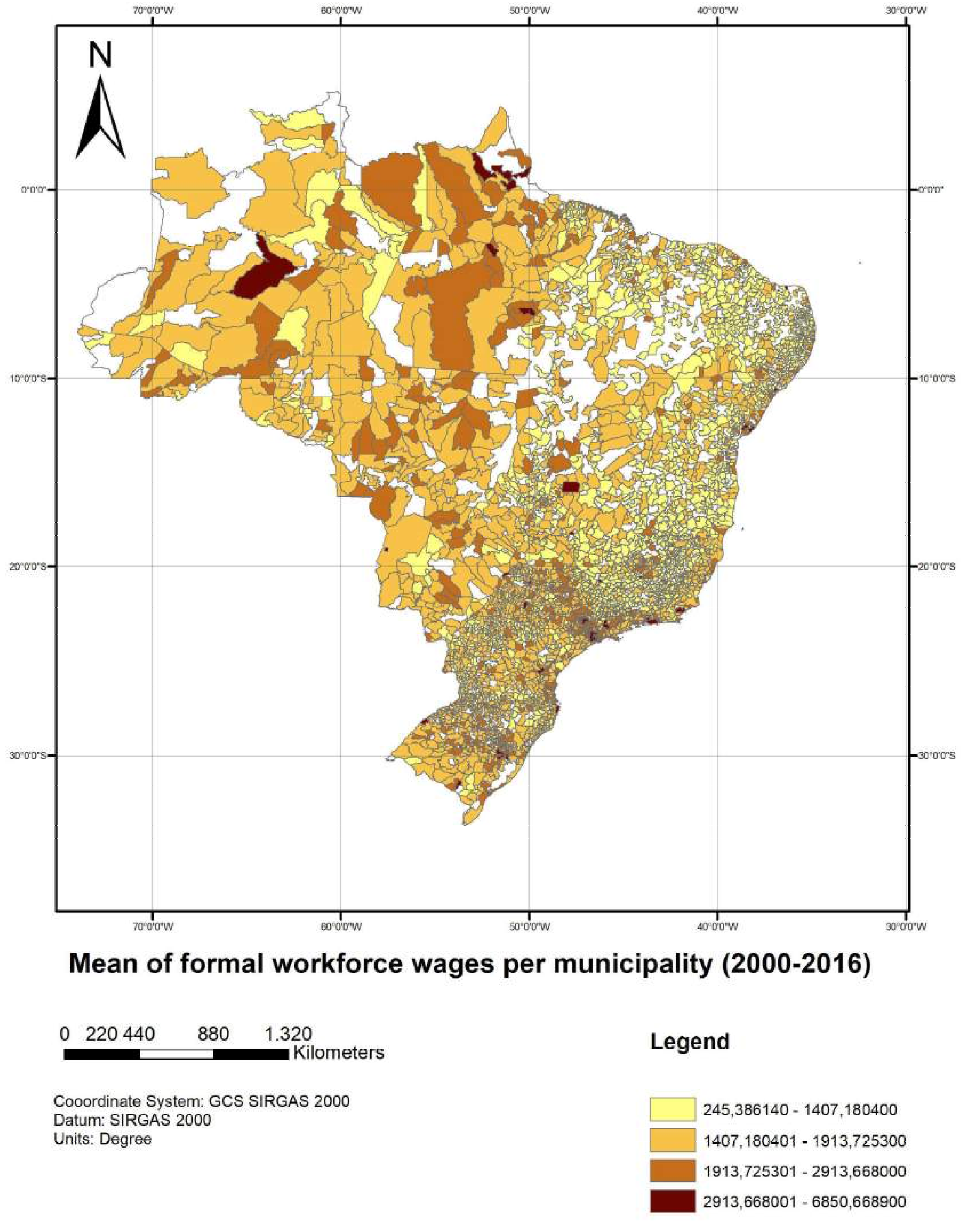
Variable	Northern	Northeast	Southeast	Southern	Midwest
Time Deposits/Total Deposits	0.171 (0.186)	0.155 (0.170)	0.242 (0.209)	0.205 (0.212)	0.226 (0.192)
Time Deposits/Credit Operations[10]	49.727 (5176.451)	0.932 (6.218)	3.944 (364.899)	1.245 (27.159)	0.894 (5.324)
Wages	1747.060 (753.537)	1486.120 (649.184)	1818.493 (802.998)	1728.226 (684.127)	1747.328 (876.308)
N-Top5	0	0.038 (0.192)	0.021 (0.143)	0.005 (0.073)	0.012 (0.108)
Capitals	0.118 (0.323)	0.037 (0.189)	0.029 (0.169)	0.019 (0.135)	0.045 (0.208)
Public	0.669 (0.470)	0.781 (0.414)	0.608 (0.488)	0.682 (0.466)	0.499 (0.490)

Note: Author's elaboration.

Now, we display, in the following figures maps containing the spatial distribution of the two dependent variables and the formal workforce wages. The three variables are averaged over all municipalities for all years. In **Figure 3**, we display the map of formal workforce wages for all municipalities present in the sample.

[10] Loans and discounted debts account in the ESTBAN data.

Figure 3 - Mean of formal workforce wages per municipality (2000-2016)

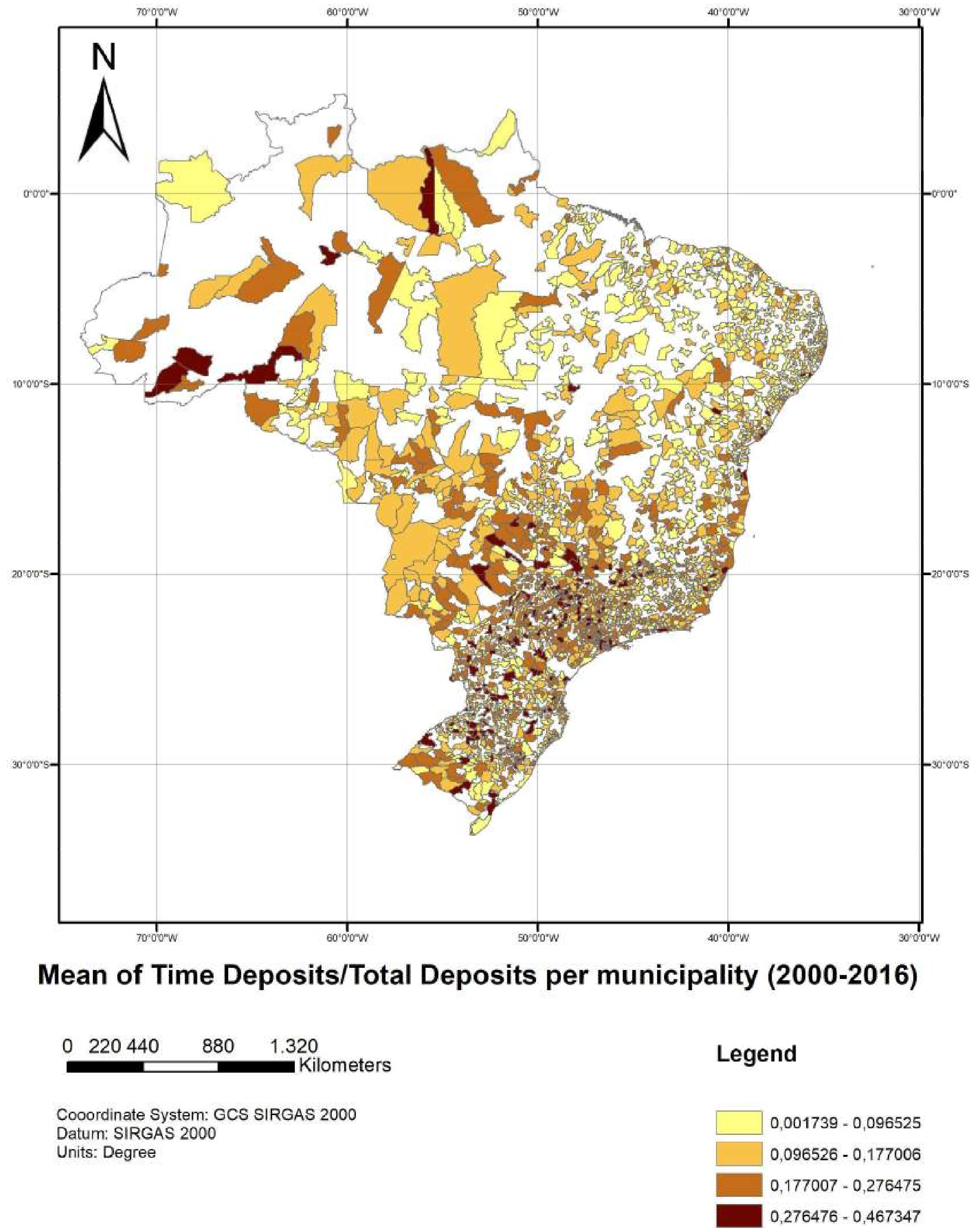


Note: Author's elaboration from RAIS data.

From **Figure 3**, higher wages tend to be concentrated in the regions Southern and Southeast, which is expected, given their higher industrial concentration and specialization.

Next, we display in **Figure 4**, a map containing the average of Time Deposits-Total Deposits ratio. Higher values of this variable in the map indicate a bigger ability of a bank branch to effectively offer their clients more medium-to-longer term products.

Figure 4 - Mean of Time Deposits-Total Deposits ratio per municipality (2000-2016)

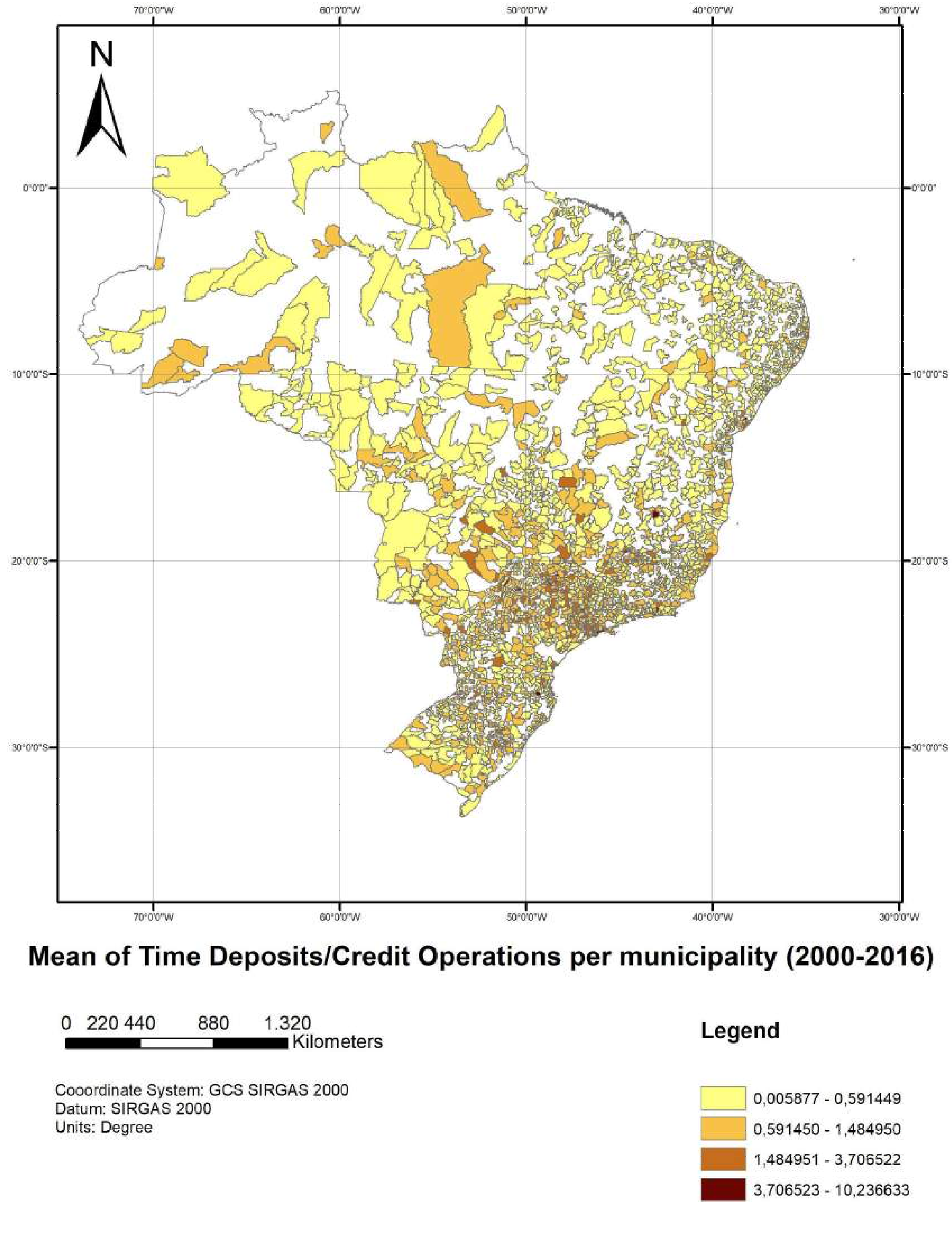


Note: Author elaboration from ESTBAN data.

From **Figure 4**, some patterns emerge. Firstly, the bank area coverage in the period considered is much more uniform in the wealthiest regions of the country, Southern and Southeast, than in the other regions, where there are large areas unassisted by banks. Next, it is also possible to affirm that banks in the Southern and Southeast regions are more able to allocate their deposits into medium-to-longer term products.

Next, in **Figure 5**, we display the average of Time Deposits-Credit Operations ratio. Higher values of this variable indicate more ability of a bank's branch to use medium-to-long term liabilities as a source of funding. In a way, it measures how comfortable it is to banks to create money from long maturity deposits.

Figure 5 - Mean of Time Deposits-Credit Operations ratio per municipality (2000-2016)

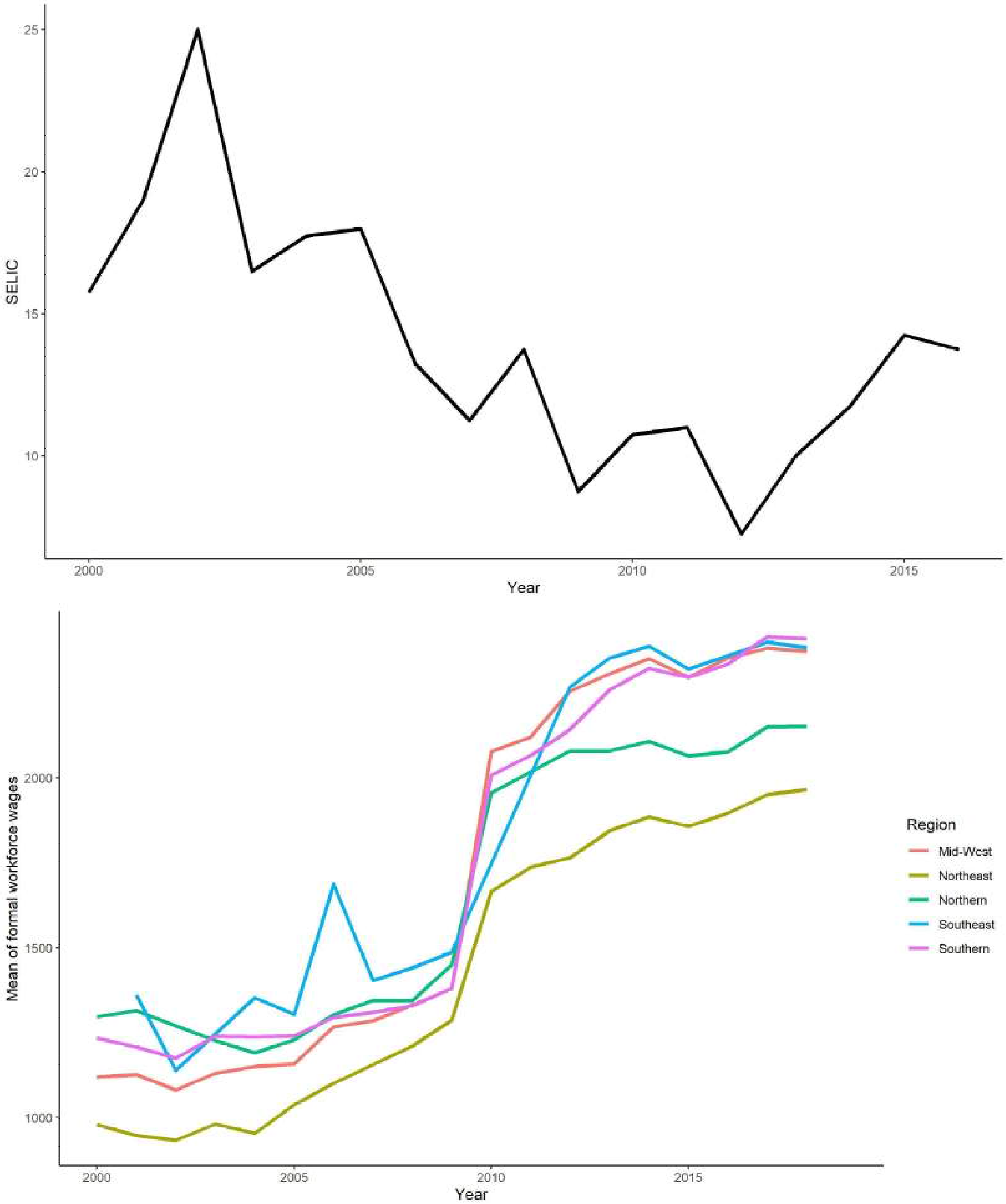


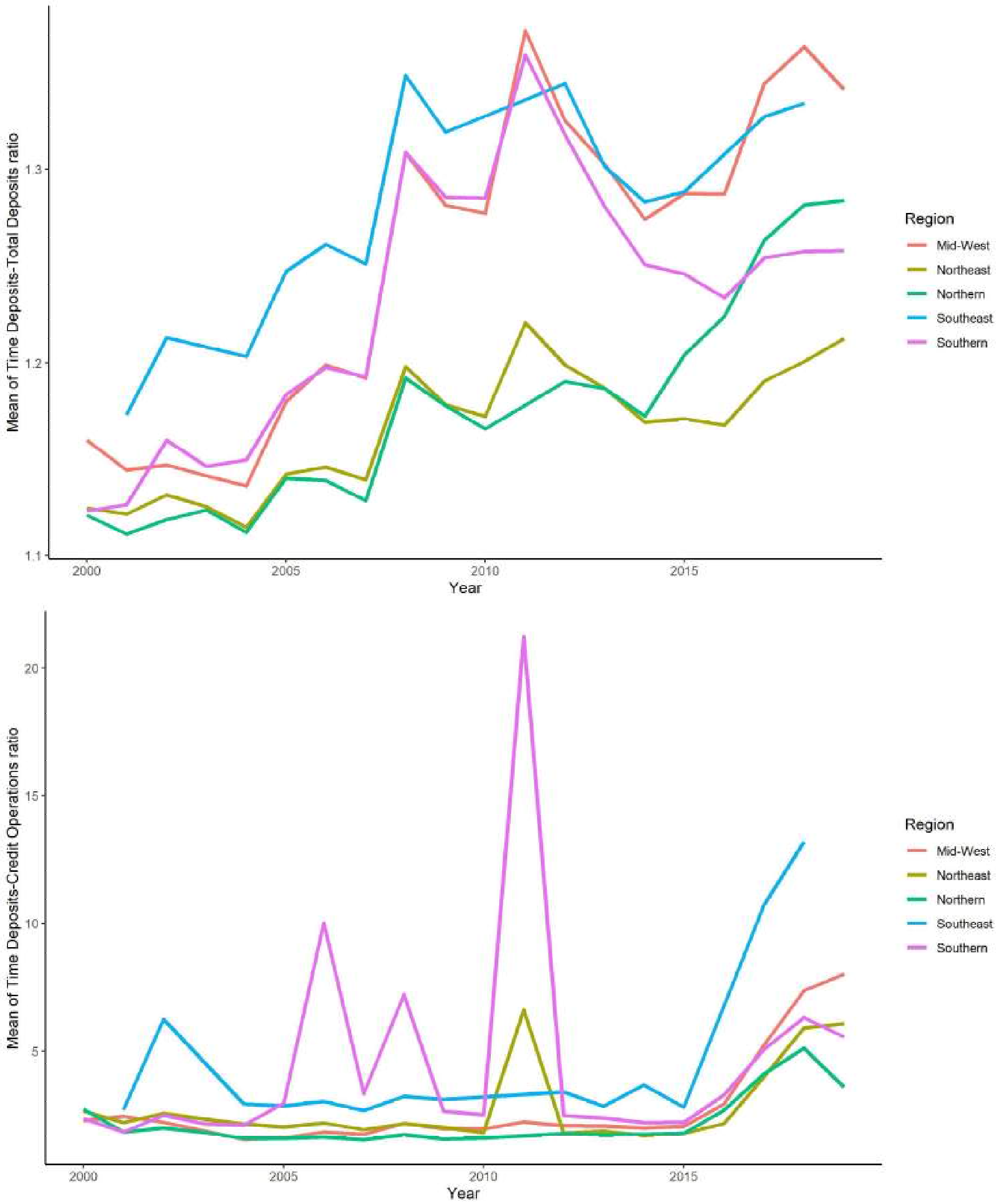
Note: Author’s elaboration.

In **Figure 5**, similar patterns from both **Figure 3** and **Figure 4** emerge, with banks in wealthier regions displaying again more leeway in implementing loans, that is, creating money.

Finally, in **Figure 6,** we display four graphs: the first (from top to bottom) is the SELIC interest rate for the period 2000-2016. Next, there is a graph containing the mean of municipal wages for all Brazilian regions in the period analyzed. Folowing, we have a graph displaying the evolution of the Time Deposits/Total Deposits ratio per year and region. Finally, in the bottom, we display a graph of the Time Deposits/Credit Operations ratio, per year and region.

Figure 6- Evolution of SELIC, wages, Time Deposits/Total Deposits, and Time Deposits/Credit Operations per year and region





Note: Author's elaboration.

From **Figure 6**, there is an overall trend of reduction on SELIC in the years analyzed, which, according to standard monetary theory, tends to ease the creation of money and also postulates a more active role for banks, as possible venues of new investment. In terms of wages, there is an overall trend of growth for all regions, with the Southern and Southeast regions gaining the most in wages growth. Next, the Time Deposits-Total Deposits ratio, similarly to the Time Deposits-Credit Operations ratio, displays a striking difference in the banking activity between Southeast, Southern, and Mid-West regions when compared to Northern and Northeast. By the bottom graphs displayed in **Figure 6**, we see a larger ability of banks in the former regions to attract time deposits when compared to the latter regions.

3.4.2 – Bayesian crossed models

In this subsection, we present and analyze the results of the Bayesian crossed models. The results for the Log(Time Deposits/Total Deposits) are presented in the following **Table 9**, with the sample divided by each Brazilian administrative region.

Table 9 - Complete model for Log(Time Deposits/Total Deposits) for all Brazilian regions

Fixed Effects	Southern	Northern	Northeast	Southeast	Mid-west
Year	0.041[s]	0.040[s]	0.058[s]	0.043[s]	0.061[s]
	(0.014)	(0.013)	(0.014)	(0.015)	(0.014)
SELIC	-0.044[s]	-0.032[s]	-0.040[s]	-0.044[s]	-0.032
	(0.017)	(0.015)	(0.015)	(0.020)	(0.016)
Capital Requirements Tightening	-0.062	-0.125	-0.097	-0.071	-0.107
	(0.143)	(0.112)	(0.118)	(0.171)	(0.124)
Reserve Requirements adapted	2.02e-10[s]	1.02e-09[s]	1.09e-10	-1.69e-11[s]	2.64e-11
	(8.01e-11)	(4.74e-10)	(1.42e-10)	(4.89e-12)	(1.32e-10)
Non-Top5	-0.279	-	0.791	0.508	-1.303
	(0.848)		(0.696)	(0.304)	(0.857)
Public	-0.344	-2.575[s]	-0.120	-0.545	0.376
	(0.665)	(1.049)	(0.468)	(0.329)	(0.471)
Capitals	0.899[s]	1.057[s]	1.664[s]	1.063	1.225[s]
	(0.299)	(0.211)	(0.249)	(0.275)	(0.220)
Wages	0.00004	0.0003	-5.98e-06	0.00007[s]	0.00002
	(0.00003)	(0.0000)	(0.00003)	(0.00002)	(0.00004)
Constant	-2.299[s]	-1.788[s]	-3.826[s]	-2.546[s]	-3.541[s]
	(0.655)	(0.858)	(0.428)	(0.269)	(0.643)
Variance Components					
Bank	2.051	5.572	0.918	0.252	1.379
	(1.429)	(13.095)	(1.029)	(0.088)	(1.646)
Municipality	0.198	0.177	0.362	0.185	0.067
	(0.023)	(0.079)	(0.041)	(0.019)	(0.023)
Municipality-Bank	0.214	0.267	0.315	0.310	0.298
	(0.015)	(0.061)	(0.027)	(0.016)	(0.031)
Year	0.053	0.035	0.037	0.059	0.040
	(0.024)	(0.018)	(0.018)	(0.028)	(0.019)
Level 1	0.589	0.559	0.736	0.724	0.602
	(0.006)	(0.014)	(0.009)	(0.006)	(0.010)

Number of banks	10	4	6	40	7
Number of municipalities	542	111	588	849	222
Number of municipality-banks	1127	203	939	1819	421
Number of years	17	17	17	17	17
Number of observations	19159	3451	15963	30923	7157
D (thetabar)	43185.68	7575.26	39527.71	76107.80	16275.52

Note: Standard deviations are reported inside the parenthesis. The ^{s} (s superscript) means that the coefficient is statistically different from 0, considering the 5% level of significance.

Now, analyzing each region's results and comparing them, we draw the following conclusions. The variable Year assumes a positive value, which can be interpreted as the starting point of our series. This variable is significant for all five regions. Next, we have the impact of SELIC, which is negative and significant, for all regions, excluding the region Midwest, for which the coefficient was non-significant at the 5% level of significance. It is worth paying more attention to this coefficient as it is of our main interest. This coefficient assumes values ranging in (-0.5,-0.3) interval, with -4,41% for the Southeast region and -3.15% for the Northern region. In practical terms, we can interpret this coefficient the following way: a 1 p.p. SELIC hike reduces the Time Deposits/Total Deposits ratio by about 30-50%, which is expected. Given that in the time considered in our analysis, there is an overall trend of reduction in the interest rates, we motivate theoretically the effect of a reduction of 1 p.p. of the SELIC. There are two effects arising from this reduction, which are: an economic recovery, implying an increase in income, Total Deposits, savings, and Time Deposits; and prices increase, by the prices channel, which makes private bonds more attractive, which, in turn, increases the Time Deposits. Moreover, a reduction in SELIC makes credit more available in the economy, which increases the inter-banking competitivity for Time Deposits. Hence, both Time and Total Deposits increase and given that our dependent variable is Time Deposits-Total Deposits ratio, which is a proxy for the liquidity of banks, a SELIC reduction tends to increase this ratio, increasing the liquidity in banks.

Following our analysis, we have that the capital requirements tightening dummy is not significant for any region. Our adapted reserve requirements, in turn, are significant, albeit with a very small coefficient, for the Southern, Northern, and Southeast regions. The signs of this variable, however, do not display a spatial pattern, given that it is positive for both Southern and Northern regions, but negative for the Southeast regions. The Non-Top5 banking institution dummy is not significant for any region. The dummy variable Public is significant only for the Northern region, assuming a negative sign, as expected. One possible explanation for this is that the public banking institutions usually deal with clients with low income and that do not spend as much as wealthier clients on a bank's product.

The variable capitals, which is related to whether or not a bank branch is located in a state capital, assumes the expected positive value for all regions, where it is significant (Southern, Northern, Northeast, and Midwest regions). The capitals' positive sign identifies that banking institutions in state capitals are more able to increase the presence of time deposits in their total deposits, which signs a deeper capacity in the creation of money in the short-run with those time deposits. Finally, the municipal centered wages mean is significant only for the Southeast region. This is expected, given that higher wages mean in the municipality implies a larger volume of workers resources flowing through the economy, which usually requires a stronger bank presence.

Analyzing the variance component in the crossed model, interesting behaviors emerge. For instance, the relevance of the banking institution in explaining the error term is relatively large for all the regions. In this way, for the Southern, Northern, Northeast, Southeast, and Mid-West regions, we have respectively that the banking institution is responsible for explaining about 66.13%, 84.27%, 38.65%, 16.34% e 57.74%. The region with the smallest influence of the banks on the error term is the Southeast region, the most developed amongst all five Brazilian regions. So, the institutional framework appears to be of lesser importance in the most populous region in Brazil (Southeast). In terms of the municipal level, for the Southern, Northern, Northeast, Southeast, and Mid-West regions, we have that the variance among the municipalities is responsible for 6.45%, 2.72%, 15.13%, 8.18%, and 2.93%, respectively. The differences among the municipalities are more important in explaining the variability in Time Deposits/Total Deposits for the Northern region than in any other region.

Now, in **Table 10**, we present the Bayesian crossed model for the variable Log(Time Deposits/Credit Operations).

Table 10 - Complete model for Log(Time Deposits/Cred) for all Brazilian regions

Fixed Effects	South	North	Northeast	Southeast	Mid-west
Year	0.010	0.007	0.013	0.025	0.066[s]
	(0.014)	(0.022)	(0.018)	(0.015)	(0.022)
SELIC	-0.027	-0.022[s]	-0.033	-0.037	-0.028
	(0.016)	(0.025)	(0.021)	(0.020)	(0.025)
Capital requirements Tightening	-0.098	-0.156	-0.088	-0.112	-0.112

	(0.134)	(0.182)	(0.162)	(0.167)	(0.195)
Reserve Requirements adapted	-6.97e-11	-3.98e-10	-3.53e-10^{s}	-2.11e-11^{s}	4.07e-10^{s}
	(9.67e-11)	(5.55e-10)	(1.56e-10)	(5.38e-12)	(1.51e-10)
Non-Top5	-0.162	-	-0.101	-0.024	-0.121
	(0.864)		(0.938)	(0.368)	(1.247)
Public	0.276	-4.390^{s}	-0.425	-0.459	1.172
	(0.765)	(1.709)	(0.526)	(0.431)	(0.640)
Capitals	1.077^{s}	1.208^{s}	1.187^{s}	1.489^{s}	1.725^{s}
	(0.328)	(0.219)	(0.264)	(0.318)	(0.275)
Wages	0.00009^{s}	0.0001^{s}	0.00002	0.00009^{s}	-0.00002
	(0.00004)	(0.00005)	(0.00003)	(0.00002)	(0.00004)
Constant	-1.212^{s}	0.680	-2.249^{s}	-1.335^{s}	-3.540^{s}
	(0.723)	(1.420)	(0.554)	(0.305)	(0.786)
Variance Components					
Bank	1.344	13.085	2.542	0.484	3.026
	(0.972)	(31.868)	(2.816)	(0.160)	(2.991)
Municipality	0.207	0.083	0.374	0.253	0.138
	(0.028)	(0.074)	(0.049)	(0.026)	(0.036)
Municipality-Bank	0.369	0.456	0.465	0.397	0.417
	(0.024)	(0.087)	(0.037)	(0.019)	(0.043)
Year	0.045	0.099	0.098	0.058	0.105
	(0.021)	(0.048)	(0.321)	(0.027)	(0.052)
Level 1	0.810	0.745	0.839	0.868	0.783
	(0.009)	(0.018)	(0.009)	(0.007)	(0.014)
Number of banks	10	4	6	40	7
Number of municipalities	542	111	588	849	222
Number of municipality-banks	1127	203	939	1819	421
Number of years	17	17	17	17	17
Number of observations	19159	3451	15963	30923	7157
D (thetabar)	49381.79	8564.88	41595.71	91698.84	18153.71

Note: Standard deviations are reported inside the parenthesis. The ^{s} (s superscript) means that the coefficient is statistically different from 0, considering the 5% level of significance.

Analyzing **Table 10**, we have that the Year variable is significant only for the Mid-West region and it assumes a positive value. SELIC, in turn, is negative and significant only for the Northern region, with a value of -0.02, which indicates that a 1 p.p. increase in SELIC reduces the quotient Time Deposits/Credit by about 2,19%. Analogously to the Time Deposits-Credit Operations ratio analysis, we explain this coefficient in terms of a SELIC reduction, which was more common during the period considered than a SELIC increase. A SELIC reduction implies an increase in Credit Operations and Time Deposits, however these accounts tend to respond at a slower pace than Demand Deposits. In particular, a SELIC reduction increases the income, which then increases more Time Deposits than Credit Operations, given that the latter account varies less than the former account.

The adapted reserve requirements coefficient is significant for Northeast, Southeast, and Mid-West regions, again exhibiting a very small size. Next, again the Public dummy is significant and negative only for the Northern region, with the fact that a bank being public reducing the quotient Time Deposits/Credit Operations by about 439%. The variable capitals, in turn, was positive and significant for all regions, indicating that the fact that a bank branch being located in a state capital contributes to the relationship between time deposits and credit. Finally, the municipal wages coefficient is positive for all regions where the coefficient is significant (Southern, Northern, and Southeast regions). This indicates again a positive impact of wages on the Time Deposits and credit.

Now, we analyze the variance decomposition for the five regions. For the Southern, Northern, Northeast, Southeast, and Mid-west regions, differences among the banking institutions correspond to 48.42%, 90.44%, 58.88%, 23.48%, and 67.71%, respectively. The lowest importance of the banking institution is again in the Southeast region, while the largest influence is in the Northern region. Now, the differences amongst the municipalities in each region account for 7.46%, 0.57%, 8.66%, 12.27%, and 3.1% for the Southern, Northern, Northeast, Southeast, and Mid-west regions, respectively. The smallest weight of the municipal differences occurs for the Northern region, while the largest weight of the municipal differences occurs for the Southeast regions. Two interesting patterns emerge from these numbers: first, the differences originated from the banks is on average more important than the differences originated from the municipalities; second, the Southeast region is characterized by a lower weight of the error explained by the banking institution (when compared to other regions) than by the municipality.

3.4.3 - Robustness: spatial panel models

As a way to analyze whether the estimated coefficients obtained from the Bayesian crossed models are robust or not, we apply spatial panel model on the same data set and the same variables. In **Table 11**, we display the results of this estimation for the variable Log(Time Deposits/Total Deposits). A table containing the total effects of each explicative variable on the dependent variable is presented in Appendix B.

Table 11 - Spatial panel models for Log(Time Deposits/Total Deposits)

	South	North	Northeast	Southeast	Mid-West
Year	0.056***	0.034***	0.063***	0.068***	0.061***
	(0.003)	(0.005)	(0.003)	(0.002)	(0.005)
SELIC	-0.051***	-0.031***	-0.044***	-0.043***	-0.034***
	(0.002)	(0.004)	(0.002)	(0.003)	(0.003)
Reserve requirements adapted	1.54e-10* (8.73e-11)	7.78e-10 (4.85e-10)	-9.98e-11 (1.50e-10)	-1.85e-11*** (5.06e-12)	-1.56e-10 (1.37e-10)
Non-top 5	-0.365	-	0.036	0,.206	-2.047***
	(0.348)		(0.167)	(0.246)	(0.354)
Public	-0.604***	-0.049	-0.196**	-0.591***	-0.259***
	(0.047)	(0.106)	(0.079)	(0.045)	(0.075)
Capital	0.579***	0.684***	1.034***	0.787***	0.471**
	(0.197)	(0.163)	(0.164)	(0.209)	(0.198)
Wages	-0.0001***	0.00009**	8.40e-07	-0.0001***	0.00006*
	(0.00002)	(0.00004)	(0.000031)	(0.00001)	(0.00003)
Constant	-2.020***	-2.582***	-3.101***	-2.248	-2.562***
	(0.055)	(0.119)	(0.088)	(0.047)	(0.086)
W*Log(Time Deposits/Total Deposits)	-0.248*** (0.029)	-0.073* (0.044)	-0.314*** (0.022)	-0.337*** (0.046)	-0.288*** (0.043)
W*Error Term	0.306***	0.084*	0.261***	0.341***	0.214***
	(0.028)	(0.048)	(0.026)	(0.045)	(0.044)
Wald test for spatial terms	119.86 (0.000)	3.25 (0.197)	163.80 (0.000)	59.45 (0.000)	45.93 (0.000)
Number of observations	19159	3451	15963	30923	7157
Number of municipalities-banks	1127	203	939	1819	421

Note: p-value: *0.1; ** 0.05; *** 0.01. The standard deviations are reported inside parenthesis.

Now, we analyze the results of **Table 11**, in conjunction with their total effects (in the Appendix). The variable Year has a positive total effect on the dependent variable, log(Total Deposits/Time Deposits) for all regions, except the Mid-West region. SELIC has a negative total value for all regions and the impact of a 1 p.p. hike in SELIC in the regions ranges from -2,97% for the Northern region to -4,69% for the Southern region. The coefficients assumed by the adapted reserve requirements have a small effect, even when they are significant (case of the Southeast region).

Continuing our analysis, the fact that a bank is non-top5 produces a negative total effect in the case of the Mid-West region. The dummy variable public has also a significant negative total effect for all regions, except the Northern region. The variable capital is also significant for all regions, with a positive total effect with the impact of a city being a state capital on our dependent variable ranging from a minimum of 42,62% for the Mid-West region to a maximum of 94,04% for the Northeast region.

The municipal wages coefficient is significant for the Southern, Northern, Southeast. It assumes a positive sign for the Northern region and a negative sign for the Southern and Southeast regions. This difference in the impact of wages on the quotient Time Deposits/Total Deposits may be due to the level of development of each region (Southern and Southeast are wealthier than Northern).

Now, we analyze the coefficients of the spatial terms. The spatial-lagged dependent variable is significant and negative for all regions, except the Northern region. Its negative sign indicates a spatial concentration of the quotient Time Deposits/Total Deposits. The Wald test for the two spatial components explicitly considered in the regression in **Table 11** indicates the significance of the spatial modeling for all regions, except the Northern region, for which the test statistic was not significant. This is further evidence of the relevance of using space as an instrument of analysis in the model.

Next, we present **Table 12**, which applies the spatial panel methods on the variable Log(Time Deposits/Credit Operations). A table containing the total effects of each explicative variable on the dependent variable is presented in Appendix B.

Table 12 - Spatial panel models for Log(Time Deposits/Cred)

	South	North	Northeast	Southeast	Mid-West
Year	0.015***	-0.009	0.007**	0.039***	0.045***
	(0.003)	(0.006)	(0.003)	(0.002)	(0.006)
SELIC	-0.029***	-0.020***	-0.031***	-0.032***	-0.030***
	(0.002)	(0.005)	(0.003)	(0.002)	(0,.004)
Reserve requirements adapted	-9.42e-11	3.07e-11	-4.40e-10***	-2.51e-11***	2.08e-10
	(1.04e-10)	(5.78e-10)	(1.65e-10)	(5.53e-12)	(1.57e-10)
Non-top 5	-0.639	-	-1.329***	-0.750***	-2.581***
	(0.426)		(0.180)	(0.257)	(0.402)
Public	-0.765***	-1.245***	-1.534***	-1.272	-0.771***
	(0.057)	(0.132)	(0.086)	(0.047)	(0.086)
Capital	0.560**	0.792***	1.112***	0.893***	0.567**
	(0.237)	(0.198)	(0.177)	(0.219)	(0.228)
Wages	-5.92e-06	0.0003***	0.00008**	-0.00005***	0.0002***
	(0.00003)	(0.00005)	(0.00003)	(0.00001)	(0.00004)
Constant	-0.102*	-0.385***	-0.138	0.039	-0.873***
	(0.057)	(0.134)	(0.089)	(0.043)	(0.093)
W*Log(Time Deposits/Total Deposits)	-0.055	-0.022	-0.072**	0.018	-0.231***
	(0.037)	(0.056)	(0.034)	(0.053)	(0.050)
W*Error Term	0.133***	0.113**	0.070**	0.152***	0.403***
	(0.037)	(0.056)	(0.035)	(0.055)	(0.045)
Wald test for spatial terms	23.73	11.39	5.47	54.30	11592
	(0.0000)	(0.003)	(0.065)	(0.0000)	(0.0000)
Number of observations	19159	3451	15963	30923	7157

Number of municipalities-banks	1127	203	939	1819	421

Note: p-value: *0.1; ** 0.05; *** 0.01. The standard deviations are reported inside parenthesis.

Now, we analyze the previous results from **Table 12**. The variable Year is significant and positive for the Southern, Southeast, Northeast, and Mid-West regions. SELIC, in turn, is negative and significant for all five regions. In the Bayesian crossed model, only for the Northern region, SELIC was significant. Thus, the spatial panel models postulated a significant sign for more regions. Next, the adapted reserve requirements coefficient is nearly null for all regions. The average of municipal wages, in turn, is significant for all regions, except the Southern region, and positive for Northern and Northeast regions, being negative for the Southeast and Midwest regions. In the case of Time Deposits/Credit, the spatially lagged dependent variable is significant and negative for the Mid-West and Northeast regions, indicating a spatial concentration of the credit in the banks for this region. The Wald test for the two spatial components explicitly considered in the regression in **Table 12** indicates the significance of the spatial modeling for all regions, except the Northeast region, for which the test statistic was not significant. This is evidence of the importance of considering the spatial relationship among banks.

3.5 - Final Remarks

In this chapter, we sought to analyze the impact of SELIC and other variables on the credit variables at the level of a bank in a municipality, from the ESTBAN data. By deploying both crossed and spatial panel models, we find a strong and negative relation between SELIC and loans made at the level of bank in a municipality.

Moreover, the separation between Brazilian banking data among the five regions proved itself crucial at capturing differences of the impact of monetary policy in the Brazilian regions, with the Southeast and Southern regions displaying much more resilience against a contractionary monetary policy in comparison to the other regions, namely Northern, Northeast, and Mid-West regions.

Moreover, the source of variance in the dependent variables, quotients of time deposits, total deposits, and credit operations, were different among the regions. In terms of time deposits-total deposits, the institutional reality accounts for a minimum of 16,34% variance of the error term, corresponding to the Southeast region. On the other hand, the municipal reality accounts for a maximum of 15,13% of the variance of the error, corresponding to the Northeast region.

In terms of the time deposits-credit operations ratio, the institutional reality in the models seemed to be more important for the Northeast and Midwest regions, while the municipal reality seemed more important in the Southeast and Northeast regions. However, even the influence of these two facets in this variable are not in same order of magnitude. While the municipal reality accounts for the maximum of 12.27% of the error variance for the Southeast region, the institutional reality accounts for a minimum of 48.42% of the error variance for the Southern region. This comparison allows to say that, even considering different regions, the institutional reality is at least four times more able to explain the error present in our model for the time deposits-credit operations ratio. Compared to the maximum of the municipal variance decomposition and the minimum of the institutional variance decomposition for the time deposits-total deposits ratio, the difference between minimum and maximum are wider in the case of the time deposits-credit operations ratio than the case of the time deposits-total deposits ratio.

Further research in this topic should direct attention to other macroeconomic, institutional, and municipal (local) variables that might help explain the credit profile of a bank in a certain locality.

Concluding Remarks

This work aimed at answering two questions: one related to the time dimension in capital flows dynamics and another related to the spatial and institutional impact of monetary policy on credit and time deposits.

The answer to the question of the dynamics of capital flows suggests the existence of different patterns in the short- and long-run movements of capital flows, that is, the long-run is not just the sum of the short-run nor the short-run is the decomposition of the long-run. In that way, this evidence opens new venues of research by finding these differences of how capital flows answer to some variables (interest rates and GDP, mostly) in the short-run and long-run, that is, there is more evidence to be gathered regarding how time affects capital flows in conjunction with the usual pull and push variables.

The answer to the impact of monetary policy on credit and time deposits alluded to different aspects of the banking activity at play: space and (banking) institution. In that way, we tended to find different coefficients for the impact of interest rates on credit and time deposits among Brazilian regions, including some of those coefficients being significant for some regions and non-significant for other regions. Furthermore, we also found evidence of different interaction between institutional and spatial realities among the regions. This and other results present challenges at modelling the banking activity in such a diverse space, such Brazil. In that way, future works that analyze the banking activity in a single state should account for spatial differences and those differences between different banking institutions.

The two research questions answered in this dissertation thesis postulates the trade-off between a monetary policy in terms of its impact on capital flows and banking liquidity and credit. In that way, a contractionary monetary policy will affect positively capital inflows, while negatively affecting bank credit and liquidity measures. This trade-off between the impact of interest rates on capital flows and liquidity/credit must not be ignored by the monetary authority, given the relevance of capital flows in affecting exchange rates and the relevance of banking credit as a growth inducer.

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Appendix

A – Capital flows models

Table A. 1- Countries in the estimation

Country	Continent	Economic Development	Country	Continent	Economic Development
Afghanistan	Asia	Developing	Kazakhstan	Asia	Developing
Albania	Europe	Developing	Kenya	Africa	Developing
Angola	Africa	Developing	Korea	Asia	Developed
Armenia	Asia	Developed	Kyrgyz Republic	Asia	Developing
Australia	Oceania	Developed	Luxembourg	Europe	Developed
Austria	Europe	Developed	Malaysia	Asia	Developing
Azerbaijan	Asia	Developing	Mali	Africa	Developing
Bahrain	Asia	Developing	Mauritius	Africa	Developing
Bangladesh	Asia	Developing	Mexico	North America	Developing
Belarus	Europe	Developing	Moldova	Europe	Developing
Belgium	Europe	Developed	Mongolia	Asia	Developing
Belize	North America	Developing	Nepal	Asia	Developing
Benin	Africa	Developing	Netherlands	Europe	Developed
Brazil	South America	Developing	New Zealand	Oceania	Developed
Bulgaria	Europe	Developing	Niger	Africa	Developing
Burkina Faso	Africa	Developing	Nigeria	Africa	Developing
Cabo Verde	Africa	Developing	Papua New Guinea	Oceania	Developing
Canada	North America	Developed	Paraguay	South America	Developing
Chile	South America	Developing	Peru	South America	Developing
China	Asia	Developing	Philippines	Asia	Developing
Colombia	South America	Developing	Portugal	Europe	Developed
Costa Rica	North America	Developing	Qatar	Asia	Developing
Côte d’Ivoire	Africa	Developing	Russia	Asia	Developing

Denmark	Europe	Developed	Rwanda	Africa	Developing
Dominican Republic	North America	Developing	Sao Tome and Principe	Africa	Developing
Egypt	Africa	Developing	Saudi Arabia	Asia	Developing
Fiji	Oceania	Developing	Senegal	Africa	Developing
Finland	Europe	Developed	Serbia	Europe	Developing
France	Europe	Developed	Sierra Leone	Africa	Developing
Gambia	Africa	Developing	Singapore	Asia	Developed
Georgia	Asia	Developing	Slovak Republic	Europe	Developed
Germany	Europe	Developed	Slovenia	Europe	Developed
Ghan	Africa	Developing	South Africa	Africa	Developing
Greece	Europe	Developed	Spain	Europe	Developed
Guatemala	North America	Developing	Suriname	South America	Developing
Guinea Bissau	Africa	Developing	Sweden	Europe	Developed
Guyana	South America	Developing	Switzerland	Europe	Developed
Honduras	North America	Developing	Tajikistan	Asia	Developing
India	Asia	Developing	Thailand	Asia	Developing
Iraq	Asia	Developing	Togo	Africa	Developing
Ireland	Europe	Developed	Trinidad and Tobago	North America	Developing
Israel	Asia	Developed	Turkey	Asia	Developing
Italy	Europe	Developed	United Kingdom	Europe	Developed
Jamaica	North America	Developing	Uruguay	South America	Developing
Jordan	Asia	Developing	Vietnam	Asia	Developing

Table A. 2- Capital inflows in the form of debt held by foreign agents

	Pooled	Fixed-Effects	GMM-Difference	GMM-System
Lag of capital inflows	0.598***	0.234***	0.220***	0.603***
	(0.0446)	(0.0629)	(0.773)	(0.0402)
PULL FACTORS				
GDP per capita	0.239***	1.395	1.944	0.254***
	(0.0720)	(0.782)	(1.920)	(0.0852)
Monetary policy interest rates	7.840	-14.23	-14.54**	7.500***
	(6.861)	(7.813)	(6.544)	(2.675)
FX-implied volatility	5.062	17.95	18.25**	6.724
	(8.516)	(18.10)	(6.987)	(8.103)
PUSH FACTORS				
USA GDP per capita	1.312	0.630	0.354	1.353
	(0.867)	(0.970)	(0.769)	(0.946)
US monetary policy interest rates	3572.9*	1897.3	2101.9	3672.0
	(1849.6)	(1916.9)	(1748.4)	(2303.8)
VIX	4287	899.4*	938.4**	436.0
	(480.7)	(510.5)	(431.2)	(358.2)
Constant	-78509.1*	-67730.5	-	-81189.4*
	(42962.1)	(4468651)		(47374.0)
Nº of obs.	349	349	258	349
Nº of countries		90	82	90
Nº of instruments			68	92
R^2	0.442	-0.182		
P-value of the AR(2) test			0.152	0.178
P-value of the Hansen test			0.0911	0.382

Source: Author's elaboration.

Note:

1- * p<0.1;** p<0.05; ***p<0.01.

2- The errors are robust to heteroskedasticity and autocorrelation and they are reported inside parentheses.

3- Hansen test has a null hypothesis that all instruments are jointly valid, that is, they are endogenous concerning the errors.

4- AR(2) test has a null hypothesis that the first difference of the errors is not correlated to its second lag.

5 – All push variables were considered exogenous, while all pull variables were considered endogenous. Up to 4 lags were used in case of the instrument matrix for the endogenous variables, with the collapse option used for the GMM-Difference model.

Table A. 3- Capital outflows in the form of debt held by domestic agents

	Pooled	Fixed-Effects	GMM-Difference	GMM-System
Lag of capital outflows	0.508***	0.0831	0.0268	0.462**
	(0.0512)	(0.0639)	(0.118)	(0.178)
PULL FACTORS				
GDP per capita	0.310***	1.117**	1.537	0.364***
	(0.0563)	(0.564)	(1.048)	(0.134)
FX-implied volatility	2.736	5.629	5.350	2.468
	(8.467)	(13.74)	(7.464)	(4.886)
Monetary policy interest rate	1.092	5.357	5.780***	1.671
	(5.197)	(5.465)	(1.835)	(2.307)
PUSH FACTORS				
American GDP per capita	2.070***	1.430**	1.184	2.043***
	(0.663)	(0.707)	(0.857)	(0.748)
American monetary policy interest rate	5504.3***	4265.6***	4290.1***	5357.4***
	(1414.6)	(1385.7)	(1507.6)	(1834.1)
VIX	-729.7*	-112.5	-100.2	-656.9***

	(372.2)	(376.0)	(311.8)	(225.8)
Constant	-96512.7***	-87053.4***	-	-97015.8**
	(32803.3)	(32556.0)		(37771.8)
Number of observations	341	341	253	341
Number of countries		87	80	87
Number of instruments			78	92
R^2	0.414	-0.279		
P-value of the AR(2) test			0.158	0.177
P-value of the Hansen test			0.235	0.418

Source: Author's elaboration.

Note:

1- * p<0.1;** p<0.05; ***p<0.01.

2- The errors are robust to heteroskedasticity and autocorrelation and they are reported inside parentheses.

3- Hansen test has a null hypothesis that all instruments are jointly valid, that is, they are endogenous concerning the errors.

4- AR(2) test has a null hypothesis that the first difference of the errors is not correlated to its second lag.

5 – All push variables were considered exogenous, while all pull variables were considered endogenous. Up to 4 lags (and the maximum available for GMM-Difference) were used in case of the instrument matrix for the endogenous variables.

B- Total effects of the spatial panel estimation

Table B. 1- Total effects of each variable for the spatial panel models for Log(Time Deposits/Total Deposits)

	South	North	Northeast	Southeast	Mid-West
Year	0.0513***	0.033***	0.058***	0.063***	0.056
	(0.003)	(0.005)	(0.003)	(0.002)	(0.004)
SELIC	-0.047***	-0.029***	-0.039***	-0.039***	-0.031***
	(0.002)	(0.004)	(0.002)	(0.002)	(0.003)

Reserve requirements adapted	1.42e-10* (8.03e-11)	7.58e-10 (4.68e-10)	-9.07e-11 (1.36e-10)	-1.72e-11*** (4.72e-12)	-1.41e-10 (1.24e-10)
Non-top 5	-0.335 (0.319)	-	0.033 (0.152)	0.192 (0.229)	-1.854*** (0.321)
Public	-0.555*** (0.045)	-0.048 (0.103)	-0.178** (0.073)	-0.550*** (0.043)	-0.235*** (0.068)
Capital	0.533*** (0.181)	0.661*** (0.159)	0.940*** (0.149)	0.733*** (0.195)	0.426** (0.180)
Wages	-0.0001*** (0.00002)	0.00008** (0.00004)	7.64e-07 (0.00002)	-0.0001*** (0.00001)	0.00005* (0.00003)

Note: p-value: *0.1; ** 0.05; *** 0.01. The standard deviations are reported inside parenthesis.

Table B. 2- Total effects of each variable for the spatial panel models for Log(Time Deposits/Credit)

	South	North	Northeast	Southeast	Mid-West
Year	0.015*** (0.003)	-0.008 (0.006)	0.007** (0.003)	0.039*** (0.002)	0.041*** (0.005)
SELIC	-0.028*** (0.002)	-0.019*** (0.005)	-0.029*** (0.002)	-0.032*** (0.002)	-0.027*** (0.004)
Reserve requirements adapted	-9.23e-11 (1.02e-10)	3.04e-11 (5.72e-10)	-4.30e-10*** (1.61e-10)	-2.52e-11*** (5.57e-12)	1.92e-10 (1.45e-10)
Non-top 5	-0.6267 (0.418)	-	-1.298*** (0.177)	-0.753*** (0.259)	-2.379*** (0.373)
Public	-0.750*** (0.058)	-1.232*** (0.143)	-1.498*** (0.089)	-1.278*** (0.053)	-0.711*** (0.082)
Capital	0.549** (0.232)	0.784*** (0.196)	1.085*** (0.172)	0.897*** (0.219)	0.522** (0.211)
Wages	-5.81e-06 (0.00002)	0.0002*** (0.00004)	0.00008** (0.00003)	-0.00005*** (0.00002)	0.0002*** (0.00004)

Note: p-value: *0.1; ** 0.05; *** 0.01. The standard deviations are reported inside parenthesis.